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THE IMPORTATION OF TETRASTICHUS XANTHOMELAENAE (ROND.)

By L. O. HOWARD

The imported elm leaf-beetle (*Galerucella luteola*), first appeared in this country about 1837 at Baltimore, and has spread to the northeast above Boston and south into North Carolina. It has within comparatively recent years crossed the Appalachian chain of mountains and has begun to spread throughout the Middle West. It has practically no effective American natural enemies, and has increased and spread unchecked, except for such work as has been done by cities and towns and except for unfavorable climatic conditions. In Europe there exist one or more egg-parasites of this and congeneric hosts. In 1832 Boyer de Fonscolombe described one of these egg-parasites as *Pteromalus gallerucae*. In 1898 Kawall described *Pteromalus ootonus* from the eggs of *Galerucella viburni*. In 1877 Rondani described *Oomyzus xanthomelaenae*. With the possible synonymy of these forms we have nothing to do.

In 1905 Dr. Paul Marchal published in the Bulletin de la Société Entomologique de France for February 22 a paper entitled "Observations Biologiques sur un Parasite de la Galéruque de l'Orme," to which he gave the name *Tetrastichus xanthomelaenae* (Rond.). In this very interesting article Doctor Marchal called attention to the fact that the elm leaf-beetle had multiplied for several years in a disastrous way about Paris, skeletonizing the leaves in the parks and along the avenues in much the same way as is so familiar to the residents of cities in the eastern United States. But with 1904 the ravages apparently stopped, and Marchal's observations indicated that this was largely if not entirely due to the work of this egg-parasite.

"My observations have not been sufficiently complete so that I can state that the egg-laying puncture is made in a different way from that just described, and that, for example, the numerous thrusts of the piercing organ may not be intended to disarrange the contents and to arrest the embryonic development.[1]

"If I can get sufficient material, it appears to me that it would be quite possible this year, by commencing to make these observations at an earlier date, to learn more accurately the history of the curious phenomena which accompany the egg laying of this species. I shall hope to find out also how the other generations go on and in what condition and in what stage the Tetrastichus passes the winter, and whether it can attack other eggs than those of the elm leaf-beetle."

Visiting Doctor Marchal in June, 1905, after the publication of this interesting article, the writer asked him whether he had been able to make his further observations, and he replied that the elm leaf-beetle had so entirely disappeared in the vicinity of Paris that he had not been able to do so. The writer urged him to make an effort through his correspondents to secure parasitized eggs of the Galerucella for sending to the United States in an effort to introduce and establish this important parasite on this side of the Atlantic. It was considered practically hopeless to attempt the introduction that summer, as the time was so late and it was not then known just in what part of France the elm leaf-beetle could be found abundantly. During 1906 practically the same conditions existed; a locality was found, but the parasites did not seem to be present. In 1907, reaching Paris about the first of May, the writer again reminded Doctor Marchal of his desire to import the parasite into the United States, and, meeting Mr. Charles Debreuil, of Melun, at the residence of the Baron de Guerne, the subject was brought up again, and M. Debreuil later in the season forwarded eggs of Galerucella to the United States, which were promptly sent to the parasite laboratory at North Saugus, Mass.; but the time was too late and the parasites had emerged and died.

In April, 1908, the Entomological Society of France was good enough to publish in its Bulletin (No. 7), page 86, a request from the writer that eggs of the elm Galerucella should be sent to the United States for the purpose of rearing parasites. This notice brought a speedy and effective response. About the 20th of May, Professor Valery Mayet, of Montpellier, France, a personal friend of the writer, secured a number of leaves of the European elm carrying egg-masses of the Galerucella, placed them in a tight tin box and mailed them to the writer's office in Washington. They were received on

[1] "This hypothesis appears to me somewhat probable. The arrest of the embryonic development of the host seems really a condition useful for the evolution of the egg of the parasite, and one of the functions of the multiple thrusts of the ovipositor is rather probably to stop it."

May 28th and at once forwarded to Mr. W. F. Fiske, of the Bureau of Entomology, in charge of the parasite laboratory at Melrose Highlands, Massachusetts. This course was taken since at the time mentioned no localities for the elm leaf-beetle were known in Washington and for the past few years this species has been very destructive in the vicinity of Boston. The package was in some way or another subjected to considerable delay in its transmission from Washington to the laboratory at Melrose Highlands, but it finally arrived there on June 1st—twelve days from the time it started at Montpellier. The

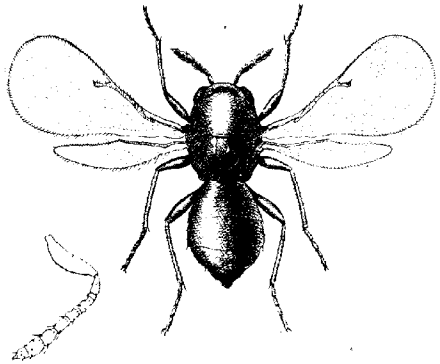


FIG. 7. *Tetrastichus xanthomelaenae* Rondani, adult female, very greatly enlarged; antenna, still more enlarged, at lower left.

early seasonal start was possible for the reason that Montpellier, as is well known, is in the extreme south of France. On opening the box, Mr. Fiske found a considerable number of active adults of the Tetrastichus. Most of them were placed in a large jar containing leaves of the elm upon which were newly deposited masses of the eggs of the Galerucella. This beetle was very abundant at Melrose at the time, and no difficulty was experienced in getting large quantities of eggs. A few parasites were used in reproduction experiments in small vials and tubes, but these experiments were not successful, since the eggs dried rapidly and the parasites themselves were short-lived in such extreme confinement. The females were at once attracted to the egg-masses, and probable oviposition was noticed within an hour after the receipt of the shipment.

Mr. Fiske was able to confirm most of Doctor Marchal's observations indicated in the translation above, but it appeared to him that the female did not always take as much time as Doctor Marchal's notes would indicate. They were several times noticed feeding upon

the contents of the egg as the contents issued from the wounds made by the ovipositor, and this appears habitual and probably necessary for the continued well-being of the adults. There were probably somewhat more than one hundred adults received in the shipment, and very few emerged from the imported egg-masses after the first day. Several different methods of rearing were tried, but the most successful were in the large jar already mentioned. In this jar adults lived surely for 35 days—a remarkable longevity, indicating that they are probably naturally active and engage in oviposition throughout the egg-laying period of the host.

From Mr. Fiske's notes, the following are quoted:

"On June 1, parasites placed in the jar.

"On June 4 they were still very active, and fresh foliage, with beetle eggs, was added.

"On June 8 another addition of fresh foliage with eggs was made.

"June 11, the parasites, of which the larger part were still alive, were carefully transferred to a fresh jar, with newly gathered egg-masses. The Tetrastichus continued active, and were noted ovipositing from day to day.

"June 18, the parasites were still active, and fresh foliage was added.

"June 23 the parasites still living were transferred to a fresh jar. There were at least twenty in all.

"June 26, they were still active, and fresh eggs were added.

"June 29, more fresh eggs were added; a number of the parasites were active and apparently ovipositing.

"July 1, there was still a small number of the parasites living, and these were carefully transferred to a fresh jar.

"July 5, several were noted still active, but after that date none was observed.

"Reproduction occurred in all of the jars above mentioned, though in the last it was very scanty. There is no possibility that any of the parasites noted from time to time were other than the originally imported females (the males died very soon after receipt), and the remarkable longevity of the species may be considered as established. It is reasonable to suppose that they would have lived longer in the open under natural conditions than in confinement.

"Very few observations on the larval habits were made. The first larvae were found on June 9, at which time they were in what appeared to be their second stage. They were, at this time, so small as to be almost invisible to the unassisted eye, and were very active when separated in a drop of water from the surrounding mass of the egg substance in which they were feeding. In this stage they are somewhat remarkable for an armature of minute spines, a row of which borders each of the abdominal segments posteriorly. The last abdominal segment terminates with a somewhat more elaborate arrangement of spines.

"After reaching this stage their growth is very rapid, and in three or four days more, last-stage larvae were found commonly in egg-masses from several

the reproduction experiments which were conducted in large tubes. The first full-grown larvae were found on the 11th, but it is probable that these were more advanced upon the 9th than those actually observed upon that day.

"Young larvæ were found in eggs which contained the beetle embryo sufficiently developed to show traces of the legs and head. Many eggs containing embryos further advanced were examined at the same time, and, though these seemed to be dead as the result of oviposition by the parasite, no parasite larvae could be found. The parasite will oviposit, or appear to oviposit, in eggs containing beetle larvae fully formed, but it is doubtful if, under such circumstances, reproduction ensues.

"In laboratory reproduction it is better not to have the eggs too fresh, as they are much more likely to wither, if kept dry, or mold if kept damp, than eggs several days old. It was first supposed that perfectly fresh eggs would be better. A lot of beetles was confined indoors with elm leaves, and the newly deposited eggs used in reproduction experiments. All of these experiments were failures. In the open, with eggs on living foliage, the results would probably be different.

"Pupae were first noted on the 15th. The distinctive coloration of the parasitized eggs was also noted at this time, and it was found possible to separate those containing parasites by their color alone.

"These parasitized eggs are somewhat suggestive of those containing larvæ nearly ready to emerge, but lack the characteristic greenish hue. They are grayish in tint and have a dull, dead appearance. They are frequently somewhat withered, and in the case of those from the reproduction experiments, were frequently covered with a scanty growth of mold.

"The first adults of the new generation emerged on June 21, and appeared in considerable numbers on that date. This would indicate a life cycle of 20 days, as it appeared that oviposition began at once upon the receipt of the parasites.

"Later generations developed more quickly. From the jar started on June 11, reproduction was secured on June 29, 18 days later. From the fresh egg masses placed in the same jar on June 18, reproduction was secured 16 days later, on July 4. From the first lot of fresh eggs placed in the third jar, to which the parasites were transferred on June 23, abundant reproduction was secured on July 8, after but 15 days had elapsed. From the fresh eggs added to this jar on June 26, reproduction was secured on July 11, another fifteen-day period. The last jar, to which the parasites were transferred on July 1, contained, on July 15, adults in very small numbers, of what must be their progeny, indicating a life cycle of but 11 days.

"This gradual reduction in the length of the life cycle as the season advanced is peculiar, and no explanation is offered. The average temperature during the latter part of June and first of July was higher than during early June, but there hardly seems to be enough difference to account for six days shortening of the life cycle of an insect which develops as rapidly as Tetrastichus."

The adult parasites secured by laboratory reproduction were liberated in two localities near Boston, and parasitized eggs were sent to Prof. J. B. Smith at New Brunswick, New Jersey, and to Prof. M. V. Slingerland at Ithaca, New York, and the remainder were sent to

Washington, since about the middle of July considerable damage by the elm leaf-beetle was noticed in the latter city on certain streets.

The first of the Massachusetts colonies consisted of about 600 parasites, enclosed in an open tube and tied to a tree in Harvard Yard, Cambridge, on June 22d. Mr. Fiske thinks that more than a hundred adults found their freedom on the day of liberation and almost certainly the full 600 within a week thereafter. Fresh eggs were abundant upon the trees for some time thereafter, and the outlook there is very hopeful.

Writing on July 29, Mr. Fiske states that he has found eggs of the Galerucella nearly a quarter of a mile from the site of the colony, and that these appeared to be parasitized.

At Melrose Highlands, Mass., more than 1,200 adults were liberated between the 21st of June and the 8th of July, and unhatched eggs were noticed on to the end of July.

The eggs sent to Dr. John B. Smith reached him in good condition and a number of the parasites had already issued on the journey. They were very lively and he liberated them upon a small elm that had some egg clusters and is so situated that he will be able to watch it without difficulty during the summer of 1909. There are also plenty of large trees nearby, so that there will be no difficulty in the parasites flying from one tree to another. The number of parasites Doctor Smith considered to be too few to risk dividing them up.

From the material sent to Prof. Slingerland, at Ithaca, only a few adults issued, and before fresh eggs could be found these had died.

The parasitized egg masses received in Washington were taken to Dupont Circle, and the leaves upon which they were deposited were tied among the branches of the first elm on the north side of New Hampshire Avenue south of the Circle, and the fourth elm on the south side of the avenue. Native eggs were abundant.

So much for the introduction and rearing of a complete laboratory generation, and for the colonization of the species. As to the establishment of the species, there is one note to add. A small lot of fresh eggs collected in the vicinity of the Melrose field colony by Mr. Fiske produced a number of parasites on the morning of July 27. In consideration of the small number of eggs collected, it seems practically certain that there must have been a very abundant natural reproduction of the parasites, and the probabilities are that the species at this date of writing exists in thousands at Melrose. The writer has every hope that the species will pass the winter successfully, and that the eggs laid next summer will be abundantly parasitized in the natural way.

The importance of this importation will be readily understood by all entomologists as well as by all shade-tree lovers, and it is an interesting example of what may be done in this way. The thanks of all good Americans are due to Doctor Marchal, Monsieur Debreuil, and Professor Valery Mayet for their assistance in this important work.

THE INTRODUCTION OF IRIDOMYRMEX HUMILIS (MAYR) INTO NEW ORLEANS

By E. Foster, *Vice-President Louisiana Society of Naturalists*

The exact period of the introduction of the ant *Iridomyrmex humilis* (Mayr) into New Orleans must necessarily remain somewhat of a mystery. The source from whence it came has been also the cause of some dispute among the citizens. On more than one occasion it has been advocated that the insect was introduced during the time of the Cotton Centennial Exposition, held in Audubon Park during 1884 and 1885, and only quite recently I have seen the view expressed in the public press that it first invaded the port by way of the Algiers and Gretna, or west side of the Mississippi River. For these theories there is, in my opinion, little foundation.

Prof. Wilmon Newell has named this pestiferous insect the "Argentine Ant," from the fact that it was first described from specimens collected during 1866 in the neighborhood of Buenos Ayres. Against the adoption of this proposed popular name there can be no objection, although the insect is well-known in Brazil, and from the fact that all evidence point to this latter country as the native habitat of the first individual, or batch of individuals to land on our wharves, it might more appropriately have been named after the "place where the nuts come from."

New Orleans has had no direct commercial intercourse with the Argentine Republic; at least, in the form in which such an insect would be likely to be introduced. In the case of Brazil, however, it is quite a different matter, for cargoes of coffee have been coming to New Orleans almost since the date of the Louisiana Purchase, and certainly since the passage of the Compromise Act of 1833, when the abolition of the duty gave a great impetus to importations. But it is needless to speculate as to whether the ant landed on the wharves as far back as that date, and, moreover, my days have not been "long enough in the land" to hark back for the better part of a century.

It is an axiom that an insect pest visitation starts somewhat like a fire which, if not quenched in the incipient stage, spreads rapidly once

it has got a good hold. We have the case of the cotton boll weevil in point. When this insect first crossed the border at Brownsville, Texas, it was looked on as something insignificant except by the few, and I may state without being accused of boasting, that among this small minority were numbered the officials of our State Experiment Station. Just how much the spread of the boll-weevil has cost our cotton planters during the few years it has been with us is well known. That *Iridomyrmex humilis*—that "stranger within our gates"—has been introduced and has spread to an extraordinary extent—to such an extent as to threaten at least two of our great staples, on the one hand through its care of scale insects and plant lice; on the other through its antagonism to certain species of beneficial insects, notably the ant *Solenopsis geminata*—there is now every evidence, and it is a question whether any effective measures can be started even at this early date and the insect's comparatively small range in the South. It is but another proof of the spreading of the fire through failure to quench it at the start, and I venture to say that hereafter the people of this section, at least, will give ear to the warnings of our economic entomologists.

From about 1891 to 1900 I was very much interested in the group of aculeate *Hymenoptera*, of which the ants form a no insignificant branch, and while my collecting was mainly confined to the Fossorial or "Digger" wasps, the hunt naturally led me more or less into contact with the *Formicidae*. During the early years of this period I collected rather assiduously along the levee front at Audubon Park and in the park itself, a field where the insect would have been comparatively conspicuous if it had been introduced by the exhibits at the Exposition of 1884–1885; at least, this can be assumed from our present knowledge as to its rapid increase. At that time our form of the large Carpenter Ant (*Camponotus herculeanus*, sub species *pennsylvanicus*) was quite a common insect, together with a very minute black ant which seems to live symbiotically; at least, that is the conclusion I have come to, for I have on many occasions found the two species together. What I took to be the American form, or one of the many subspecies of *Formica sanguinea* Fabr. was also present in numbers and the small yellow, or "pavement" ant (*Monomorium pharaonis* Linn.), also the red ant *Solenopsis geminata* Fabr.—the one with fire at both ends—were very abundant, while another comparatively large fuscous form with a darker patch on the thorax was to be found abundant on the trees fringing the river. There were others, notably *Lasius flavus* De Geer, but it is needless to go into their names even if I could place them definitely. Today all of these species are

comparatively scarce in the Park section. *Iridomyrmex humilis*, which was then practically absent as far as my observations went, has almost displaced the lot. So much for the upper end of the city.

In 1893 my newspaper duties began to take me down daily into the neighborhood of the Sugar Exchange, or two squares below Canal Street and within a very short distance of the river. The variety or sub species of *F. sanguinea* was common; in fact, I watched one nest located at the corner of the sheds on N. Peters and Bienville streets until four years ago; since then it has mysteriously disappeared. Practically all of the species (with the exception of *Camponotus*), just noted for Audubon Park were quite common in this locality. *I. humilis* was present, but it was very scarce. Today this latter species seems to have almost completely supplanted the others and has become a veritable pest. Collecting at this period was also done in the neighborhood of the slaughter houses, some three miles below Canal Street. It was a rare insect there until 1895 or 1896. This covers my observations for the lower end of the city.

In these early days of entomological activity I lived on St. Charles Avenue, nine squares from the river and twelve from Canal Street. In 1891 the ant was there in fair numbers but in nothing like the hordes it is today. That it had made its way east from the river seventeen years ago may thus be taken as established; how far east I am unable to say, but I have no recollection of having seen it at this period at the West End resort on Lake Pontchartrain. Five or six years later I was living on Peters Avenue, near St. Charles Avenue and in the uptown district. *I. humilis* was then present but not abundant. Thus uptown it had extended its range not only to the north but east as well. In 1904 Mr. Titus, of the government Bureau of Entomology, found it prevalent all over this district, and across the Mississippi River as far west as Lafayette and Opelousas, while Mr. Newell now reports it from Lake Charles. In 1906 I did not notice it at the Gulf Biologic Station, some fifty miles south of Lake Charles, but I have little doubt but that it has reached there, seeing that there is constant steamboat communication between the two places.

I have no recollection of having seen the insect in the early nineties while collecting at Shell Beach, on Lake Borgne, neither have I any notes of its presence at Abita Springs, Slidell, Pearl River or Mandeville, all on the east side of Lake Pontchartrain and where it is decidedly the most abundant species now. *Solenopsis geminata* and *Monomorium pharaonis* were the most conspicuous of the red ants, while *C. herculeanus*, sub species *pennsylvanicus*, was just as common in the woods. At all of these stations *I. humilis* seems to be ousting all other species.

As to the possible site of its introduction: Mr. Chas. Dittmar, one of the best posted coffee importers in New Orleans, informs me that previous to 1890 all coffee steamers discharged at the wharves located between Julia and Orange streets, never further up the river than the latter; in other words, the landings were made within a distance of six blocks alongside the river, or from the 12th to 18th from Canal Street. Running east to St. Charles Avenue, this district would cover the house in which I resided in 1891, and where I first made acquaintance with the insect. This stretch of six blocks was, in my opinion, the starting point from which the insect has spread east, north, south and west; that it was there, and previous to the holding of the Cotton Centennial Exposition, the first invasion was made, for the rate of increase up to 1891 would necessarily be slow, but once started and nests established such increase would naturally become more pronounced, especially as we know that no steps were taken to check the advance. Moreover, at this date no note of complaint was heard, showing that the insect did not force itself on the attention of the ordinary observer by the mere fact of numbers; in fact, I believe that it was not until the year after the relaying of the street railroad tracks on Magazine Street (about 1895 or 1896) that the procession east became so pronounced as to cause general complaints, which were reëchoed in the press of the city. In the relaying of these tracks, numbers of nests would be disturbed and the ants driven to find new quarters.

The insect was first described by Gustav Mayr in 1868[1] in an obscure annual of the Society of Naturalists at Modena, Italy, under the name of *Hypoclinea humilis*, and from specimens collected during 1866 in the outskirts of Buenos Ayres. He described only the worker ant, and it was not until February of this year that on the request of Mr. Newell, full diagnoses of worker, male and female were published by Prof. W. M. Wheeler.[2] Mayr does not mention this species in his paper on the South American *Formicidae*,[3] published in 1887, nor in his list of the *Formicidae* of the United States,[4] published the previous year, the latter of which lists all forms known from this country at that date. It does not figure in Cresson's "Synopsis of the Hymenoptera of the United States," also published in 1887. If the insect had

[1]Formicidæ novæ americanæ.

[2]Jour. Econ. Ent., Vol. I, No. 1, Feb., 1908, pp. 28–30.

[3]Südamerikanische Formiciden, Verh. zool-bot. Ges. Wien, Vol. XXXVII, pp. 511–562.

[4]Die Formiciden der Vereinigten Staaten von Nordamerika, XXXV, p. 132 et seq.

become obnoxious at that date, I think the fact would have been noted in one or other of our entomological journals, and that Cresson would have been fully in touch with it, for his work shows that he had access practically to all the literature to date.

Mayr erected the genus *Iridomyrmex* in 1862,[1] and *Hypoclinea* in 1866.[2] The species *humilis* figures in his key[3] to the genus *Hypoclinea*, published in 1870. Six years later the two genera were combined by him, he having found many connecting forms. The literature of *I. humilis* may be small, but now that the insect has become such a serious economic pest, the mere systematic work of the entomologist will give place to that dealing with the biological side. The able article contributed by Mr. Newell to the initial number of this journal shows that a start has been made along the latter lines and much data gathered on the life-cycle and habits of the insect. With a full knowledge of such life-history, remedial measures may be possible, but the problem will be an extremely difficult one to solve and it goes without saying that every citizen of New Orleans, every sugar, cotton and rice planter, every florist and horticulturist will follow anxiously each step made towards that solution.

23d June, 1908.

NOTES ON SOME CECROPIA COCOONS AND PARASITES

By John B. Smith, Sc. D.

From a number of collectors reports came during the fall and winter of 1907–'08 of an unusual mortality in *cecropia* cocoons; or, more correctly stated, that an unusual number of the cocoons were "light," with remnants of untransformed larvæ only. In a discussion before the Newark Entomological Society at its February meeting, it appeared that this trouble was widespread and yet somewhat local. Some collectors reported a very high percentage of sound cocoons in limited areas and a yet higher percentage of "light" examples in others. So there was a great difference in the species, the cocoons of *promethea* and *cynthia* running normal and mostly good. Mr. Brehme reported an unusual dearth of *polyphemus* cocoons and explained that by the statement that an epidemic disease attacked the nearly full-grown caterpillars so that they never spun up at all.

It occurred to me that it might be interesting to learn a little more

[1] Myrmecologische Studien, p. 702.
[2] Ameisen des baltischen Bernsteins.
[3] Neue Formiciden, p. 959.

accurately the cause of these "light" cocoons and, in this day of discussion of parasites, to determine if possible the relative effectiveness of parasites and other causes in checking the development and increase of certain species.

I therefore asked Mr. H. H. Brehme of Newark and Mr. J. Doll of Brooklyn to gather and send me a lot of these "light" cocoons so that I might at least approximately determine the cause of death of the larvæ that spun them.

Mr. Brehme brought in a lot of 302 cocoons, of which nine turned out to be sound; eighteen were old specimens from which the adults had emerged; forty-two were parasitized and 233 had died in the larval stage, of disease. Of the forty-two that were parasitized only a few were infested by *Ophion*, while the remainder appeared to be infested by some species that makes its cocoons in a mass.

The dead larvæ were in most cases mere shells and were filled with a powdery mass. There was some difference, however, and I judged that at least two kinds of disease organisms had been responsible for death. The interesting feature in the matter is that less than 15 per cent of the deaths had been caused by parasites and over 65 per cent by disease.

It was quite possible to separate out two series of cocoons containing diseased larvæ. In 59 of the 233, the cocoon was incomplete or imperfect; *i. e.*, the inner cocoon was very thin or practically wanting, or the outer cocoon was reduced to a mere covering of loose silk. In other words, the vitality of the larva had not been sufficient to enable the caterpillar to do its spinning work properly, although death did not ensue until after it was completed.

Two lots of cocoons were sent in by Mr. Doll, one consisting of 430 and the other of 330 specimens. Both lots were collected between Maspeth and Laurel Hill, Long Island, one lot, the 430, during the fall of 1907, the second lot, 330, during March, 1908. In the first lot the object had been to collect good cocoons and the obviously light ones were rejected in the field; in the second lot all light cocoons were taken. The first lot was part of a much larger number—over 2,000—collected as probably sound, and the material sent me was that which was sorted out as probably bad when they were again tested at home. In neither case does the material afford any clue as to the actual percentage of infestation; it simply indicates the percentage of the different causes of death.

In the lot collected in 1907, sixteen cocoons were found to contain sound pupæ, and from fifteen adults had issued, leaving 399 that had dead larvæ or pupæ. Thirty-four caterpillars had left the

pupal stage and died. Of these some had masses of white, fungous-like material with a surface coating of orange powder exuding between the segments. Others were drying up and shrivelling; a few contained a putrifying mass of yellowish material. Of the remainder, 13 were dead as larvæ and of these fifty-four had made light or imperfect cocoons. One hundred and fifty-two were parasitized, and of these twenty had *Ophion* cocoons, the remainder seeming to be Ichneumonids of some kind.

In the lot collected in 1908, eleven cocoons were found to contain sound pupæ and from one the adult had emerged. Thirteen had died in the pupal stage, leaving 305 that had died without pupating. Of these 204 were killed by disease, sixty-one of them making light cocoons, while 101, or less than half as many, were parasitized. Of those that were parasitized, fifty-six contained pupæ of *Ophion*, while forty-five only went to other species.

This little examination is interesting because it calls attention to the relative importance of control factors other than parasites. It gives the results from a lot of 1062 specimens and shows that 697, or more than 65 per cent, were killed by disease in either the larval or pupal stage.

I am quite aware that the statistics are incomplete and imperfect, since the collections were not made of *all* the cocoons in a given region; but as they go, they emphasize the importance of a study of the subject from a new standpoint.

Stated in compact form the results of the study are as follows:

Total number of cocoons examined		1062
Sound specimens	36	
Adults had emerged	34	
Died as pupæ	47	
Parasitized	295	
Dead from disease	650	1062

The above results were secured by early summer and were communicated to the Brooklyn Entomological Society at its June meeting. At that time it was announced that the parasites had begun to make their appearance and that the cocoons would be preserved until the record was complete and nothing further issued.

To all appearance there were two kinds of parasites, the *Ophion macrurum*, which was of course readily recognizable, and an Ichneumonid form, making its cocoons in a solid mass in the lumen of the *Cecropia* cocoons. There were seventy-six counted *Ophion* pupæ and from these nineteen adults were obtained. As the *Ophion* speci-

mens in the Brehme lot were not counted, it means that less than twenty-five per cent of the total number matured, and that was not because of any hyperparasitism, but a simple failure of the larvæ to make a proper pupa. This experience by the by, is not a new one to me. In years past I have cut *Ophion* cocoons in large numbers, finding sound larvæ and pupæ as exceptions only and a putrid brown semi-liquid mass as the rule. Mr. Grossbeck informs me that he has never found anything but the same pasty mass, and therefore it seems that this parasite is kept in check by some disease that reaches it within the body of its host.

Assuming that there were actually eighty *Ophion* parasites, that left remaining 215 *cecropia* cocoons containing massed Ichneumonid cocoons. The number of individuals in these masses was not determined, but there were certainly more than ten, which would make an expectation of 2,000 parasite examples a very moderate one. Instead of that we bred out, *Spilocryptus extremis*, 124 specimens, *Spilochalcis mariae*, 51 specimens; a total of 176 examples instead of the expected 2,000.

But we were not left without specimens for count, because we bred out over 48,000 examples of *Dibrachys boucheanus* or some very closely allied form. The species was referred through Dr. L. O. Howard to Mr. J. C. Crawford, and the determination was received as above, with the statement that this was a hyperparasite on Ichneumonidæ. Mr. Grossbeck actually counted 33,000 of the little specimens and estimated the balance; conservatively, I am certain, for I myself believe that the total was nearer to 50,000 examples. Assuming that the 176 *Spilocryptus* and *Spilochalcis* were the product of fifteen cocoons, that left the nearly 50,000 examples to emerge from 200 cocoons, or 250 examples from each cocoon; twenty-five hyperparasites from every true parasite.

Actually there were over 280 hyperparasites to every primary parasite and this would seem to afford a very decent check to undue increase, so as to prevent the complete extermination of *cecropia* by parasites alone.

This series of notes is published at this time as a suggestion to some of our younger investigators. An extremely valuable set of data can be secured by collecting in some limited locality *all* the cocoons of some of our large *Bombycids*, sorting them so as to separate sound from dead or parasitized forms and sorting the latter so as to separate the different kinds of parasites so far as these may be determined without interfering with their development. Collections should be made in late fall and in late spring to determine the influence of

e winter, and in due time facts would be at hand enabling us to dge intelligently concerning the actual effectiveness of parasitic eeks, for some species at least.

There is always a good chance of being misunderstood, hence it y be in place for me to say that I do not mean to suggest that rasites are of no use in checking insect increase. I know that they But I do claim that we do not know just where parasites rank effectiveness as compared with other conditions, and I do claim also t, however much under parasitic control some species may be, that is no proof that therefore all other species may be or are similarly controlled. The contrary proposition is, of course, equally true.

NOTES ON THE LESSER CLOVER-LEAF BEETLE

(*Phytonomus nigrirostris* Fab.)

By C. O. Houghton, *Newark, Del.*

This species is quite common in Delaware, where, in company with its near relative, *P. punctatus* Fab., it at times does considerable damage to clover.

The earliest date on which I have taken this species in the field in Delaware is April 12; this was in 1906. On that day I found a single brightly-colored specimen several inches down in a hollow weed-stalk, three or four feet high, in a field. I also took, on the same date, about a dozen specimens as they were floating on the water in a small ice-pond near Newark. There must have been several hundred specimens on the pond at this time, as a large number of others were seen. Apparently they had fallen into the water as they were flying over it, possibly due to the fact that quite a strong wind was blowing.

In 1905 my first specimens were taken on May 9, on which date I found three at the bases of clover plants in a sunny spot beside a railroad track. All three specimens were bright and fresh, the green being very brilliant. I placed these specimens together in a shell vial containing a few clover leaves, and soon after noticed two of the beetles apparently pairing. The next day two more specimens were taken and enclosed with the others, and that evening two pairs were observed mating. They did not appear to mind confinement and fed freely upon the clover leaves, eating small irregular holes or slits in them; they also fed somewhat upon the stems.

On the morning of May 11th the pairs were still together, and

they were observed similarly disposed at various times during the next few days. On May 17th I removed the leaves from the vial and carefully examined them for eggs. Several were found situated inter-epidermally, sometimes singly, sometimes in pairs. They were inserted through punctures sometimes made through the upper epidermis of the leaf, sometimes through the lower, apparently. The eggs were whitish in color, elliptical in outline, and measured .5-.6 mm. in length by .35-.4 mm. in width.

The development of this lot of eggs was not watched, but some that were deposited during the twenty-four hours preceding the evening of May 20, and which were dissected on May 28, were found to contain embryos apparently full grown. Again, newly hatched larvæ were found May 29 on a clover leaf which contained eggs laid during the twenty-four hours preceding the evening of May 22. Thus the time elapsing between the deposition of the eggs and the hatching of the larvæ in these two instances was about eight days. In both cases the vials containing the clover leaves were kept in a moderately cool and dark room in the house, where the temperature probably averaged 60° to 70°F. The first pupa that I obtained was from a larva which hatched in the field and was brought in a few days before it pupated. This pupa was found on May 23, and there was no sign of a cocoon. It was found lying on a leaf, with no evident attempt at concealment. When touched it wriggled vigorously.

About June 1st the first pupa in its cocoon was found. This cocoon was not unlike that of *P. punctatus*, except, of course, that it was much smaller and appeared to be more carelessly constructed. It seemed to be rougher on the outside, and the meshes not so evenly formed as in the average cocoon of its near relative. It was formed at the top of the vial, between a piece of paper and the cork.

On June 6 I found another cocoon, containing a pupa, which was attached to one of a bunch of clover leaves in a vial. Later (on June 16) I found a cocoon snugly ensconced in a clover blossom that was in one of my vials. The duration of the pupa state in one case that I observed was about four days—not more. This specimen was kept under conditions similar to those described above for the eggs.

A beetle that emerged on June 15 began at once to feed upon its cocoon and soon completely devoured it. In this case the vial enclosing the beetle had nothing else in it. Lack of other food probably accounted for this apparently peculiar proceeding, as I observed no other similar case.

None of the larvæ which hatched in confinement were carried through to maturity, so I have no data bearing upon the length of

ne required for their development. Many of the larvæ which I had der observation died after reaching full growth and before pupat- g. They would turn black and die in a short time. Some of my pæ suffered the same fate. No investigation of the cause of death s made in these cases, but it seems probable that a fungus disease milar to, if not identical with, the one which works upon the larvæ *P. punctatus* was responsible for it.

I failed to record measurements for newly-hatched larvæ, but some brief notes jotted down on May 28 are as follows: "Found two or three newly-hatched larvæ upon a clover leaf which contained eggs laid during the twenty-four hours preceding the evening of May 22. These may have been out a few hours, but not longer, I think. Larvæ are white, with black heads and a transverse black bar just back of the head, on top of the first thoracic segment, apparently." Some larvæ which appeared to be full grown and had stopped feeding were measured on May 25. They averaged about 7 mm. in length, one measuring 7.5 mm.

As evidence that the egg-laying period of this species may extend over a period of several days, I may say that on May 25 I put the original five specimens (some of which had deposited eggs previous to May 17) upon a potted clover plant under a bell jar and within eight hours several eggs had been laid, some in the usual manner and some otherwise. The unusual way in which part of the eggs were laid in this case was that a bunch of six, somewhat irregularly stuck together, was deposited upon one of the leaves.

Judging from my observations upon the feeding habits of this species, and its near relative, it is an easy matter to determine from an examination of an injured clover leaf whether this has been fed upon by the adults or larvæ of *P. nigrirostris* or those of *P. punctatus*. The former eat small holes and slits in the leaves, often near the center; the latter begin at the edges of the leaves and eat into them from the outside.

In closing these random notes on the lesser clover-leaf beetle, it may not be out of place to add a brief note made by the writer in northern New York (at Potsdam, St. Lawrence Co.) in 1902. The date is July 17, and the note is as follows: "Today I collected a larva of this species, about one third of an inch in length, which was feeding on clover. It was near the top and at the center of the plant, and had destroyed a good deal of that portion of it. I put the larva into a small bottle with some of the clover and left it, corked up, for some time. About July 28 I saw that it had turned to a pupa, and on August 1, I found the adult in the bottle."

Although *P. nigrirostris* is very common in northern New York and I have taken numerous specimens while collecting, I have made no other observations on its habits in that region. Specimens in my collection which were taken at Potsdam bear dates ranging from March 19 to August 1. As the former date is too early to expect any transformations to have taken place, it seems probable that this species hibernates as an adult.

THE OVIPOSITION OF CHILOCORUS BIVULNERUS MULSANT

By A. A. Girault

As there have been no very complete observations recorded in the literature of economic entomology in regard to the place of deposition, and the morphology, of the egg of this scale-eating ladybird, the following description of it and record of observations on the place of deposition may be of contributory value, particularly since previous observations are not in accordance with these and are more or less fragmentary.

The egg of this species has never been described, and I believe the first observation made on its place of deposition was by Fiske (1903) in Georgia, who stated that they were found in rather large numbers on the trunk of old peach trees infested with the cherry scale (*Aspidiotus forbesi* Johnson). The eggs were deposited under the coccids, in a manner somewhat similar to the mode of deposition of *Chilocorus similis* Rossi (Marlatt, 1902, 1906). However, Smith (1897) mentioned their color, relative size and shape and stated that they are "set on end in little groups, * * * and in a general way resembling the eggs of other ladybirds * *." And years previously, Townend Glover (1859) wrote that they were deposited on the leaves and trunks of trees infested with coccids. Dimmock (1906) gives no additional data.

For the past two or three years I have made more or less desultory observations on *bivulnerus*, but did not find its eggs until the middle of April, 1907, at Olden, Missouri. On a trunk of an apple tree infested with *Chionaspis furfura* (Fitch), the adults were quite abundant, and careful searches under loose pieces of the outer bark and in small crevices along the trunk disclosed the eggs deposited in such places. None were found under the coccids. I was able to prove these eggs to be those of *bivulnerus* several months later when at New Richmond, Ohio, in June, 1907, a pair of the beetles in confine-

ent deposited several eggs, in all respects identical with those found posited along the trunk of the apple tree in Missouri. A careful scription of the eggs in both cases was made. They were deposited their sides under both conditions, but in confinement I did not ceed in getting more than the few mentioned.

Again at Urbana, Illinois, May 28, 29, 1908, several females of is species were observed crawling slowly about amongst an isolated t crowded colony of *Lepidosaphes ulmi* (Linnaeus), on the trunk a Carolina poplar (*Populus deltoides carolina* L.), on the campus the University of Illinois. They were watched for four hours during the afternoon of May 28, but none were observed to deposit eggs, though their ovipositors were quite frequently exserted and inserted into crevices and openings along the bark. The females were very deliberate in their movements, crawling slowly about examining all likely crevices, stopping frequently to feed upon the minute young coccids, and occasionally to rest. They seemed to be particularly careful in selecting a place for the nidus, if such was their purpose. It was not until waiting several hours on the following morning that actual deposition was observed. The females were behaving as formerly, but at 11 a. m., May 29, one of them paused longer than usual while examining a crevice with the ovipositor, and finally she was seen to pass a single egg. This was deposited under a scale of bark, and the egg was very well hidden. This egg was cut out of the crevice and compared with the others found scattered in similar places through the coccid colony, and all of the females were captured and confined in the laboratory, where, however, they died from neglect, without oviposition. All the eggs found in this colony of Lepidosaphes hatched in the laboratory, but I did not have time to secure data on the length of the egg instar. After death the females were kindly determined for me by Mr. Eugene A. Schwarz of the United States National Museum, Washington, D. C., as the species under consideration.

The description of the egg is appended:

Normal: Color uniformly pale chrome orange; cylindrical, slightly thickened towards the middle, the ends obtuse, subtruncate; surface shining, naked, minutely punctate (half-inch Coddington lens), with moderately close, minute papillæ, within rather large, circular, deep punctures (two-thirds-inch objective, Bausch and Lomb), the latter inconspicuous, seen faintly at the change of focus, as of an uneven surface; papillæ resemble minute punctures. Micropyle inconspicuous; chorion elastic. Length, 1.20 mm., average; greatest width, 0.65 mm., average. (From 14 specimens.)

Deposited singly or in small groups of three or four, on their sides, in crevices of the bark; attached, however, at the caudal end, along the latero-caudal margin of one side, making that margin of the egg somewhat obliquely truncate. The eggs are larger than with the more common species of the

Coccinellidæ and appear to be similar to those of *Chilocorus similis* Rossi (Marlatt, 1906). Fiske (1903) states that they are brown in color.

Literature Referred To

1859. **Glover, Townend.** Report Commissioner of Patents for the year 1858. (Executive Document No. 105, House of Representatives, 2d session 35th U. S. Congress), Washington, p. 261. "The eggs of this lady-bug being deposited by the female on the leaves or trunks of trees infested, hatch in from three to six days."

1897. **Smith, John Bernhard.** Report of the Entomologist (for 1896) in 17th Annual Report, New Jersey Agric. Experiment Station, for year ending Oct. 31, 1896, p. 522. "The eggs are bright yellow in color, and quite large in proportion to the size of the beetle. They are elongate-oval in shape, set on end in little groups, something like those of the Potato Beetle, and in a general way resembling the eggs of other lady-birds, which are not uncommonly found on leaves infested by plant lice."

1902. **Marlatt, Charles Lester.** Proceedings of the 14th Annual Meeting of the Association of Economic Entomologists, Pittsburg, Pa., June 28, 1902. Bull. No. 37, N. Series, Div. Ent., United States Department of Agriculture, Washington, D. C., p. 81.

1903. **Fiske, William F.** Proceedings of the 15th Annual Meeting of the Association of Economic Entomologists, Washington, D. C., Dec. 26, 1902. Bull. No. 40, N. series, Div. Ent., United States Department of Agriculture, Washington, D. C., p. 31.

1906. **Dimmock, George W.** Algunas Coccinellidæ de Cuba. Primer Informe Anual de la Estacion Central Agronómica de Cuba, Habana, pp. 291–292. Mentions the observations of Glover (1859), Smith (1897) and Fiske (1903).

1906. **Marlatt, Charles Lester.** The San José or Chinese Scale. Bull. No. 62, Bureau Ent., United States Department of Agriculture, Washington, D. C., fig. 11, d–g.

NOTES AND DESCRIPTIONS OF SOME ORCHARD PLANT LICE OF THE FAMILY APHIDIDAE[1]

By C. P. Gillette

The Aphididæ have been the most destructive family of insects attacking Colorado orchards for several years past. Consequently they have been objects of special study by the writer and his assistants for the last two or three years. I am giving here some of the more technical information, especially descriptions, that would be of little interest to the fruit grower.

[1]This paper is supplemental to Bull. 133 of the Colorado Agricultural Experiment Station, which deals more specially with the life habits and the means of control of orchard plant lice.

I am specially indebted to Mr. L. C. Bragg and Mr. E. P. Taylor for many of the life-history and food-plant records, and Miss M. A. Palmer has made all the drawings for the illustrations.

APHIDS INFESTING APPLE AND PEAR TREES

The Green Apple Aphis, *Aphis pomi*, DeGeer; Plate 5, figs. 1–8.

Some of the More Important Literature

Aphis pomi, n. sp. DeGeer, Memoires, III, 1773.
Aphis pyri mali, Fab. Systema Entomologica, 1775.
Aphis mali, Kaltenbach, Mon. der Fam. Pflanzenlouse, p. 72, 1843.
Aphis mali, Koch, Die Pflanzenlouse, p. 107, 1857.
Aphis mali, Buckton, Mon. British Aphides, II, p. 44, 1879.
Aphis mali, J. B. Smith, Bull. 143, N. J. Exp. Sta., 1900.
Aphis padi, Sanderson, 12th Rep. Del. Exp. Sta., p. 191, 1901.
Aphis pomi, Sanderson, 13th Rep. Del. Exp. Sta., p. 130, 1902.
Aphis mali, Quaintance, Circular 81, Bureau of Ent., 1907.

Eggs—The eggs vary little from .60 mm. in length by .26 mm. in transverse diameter. When first deposited, they are light green in color, but in the course of a few days change to deep polished black. They are scattered promiscuously over the smooth bark of the twigs. Upon hatching the shell splits longitudinally at one end, as shown on Plate 6, Fig. 20. Hatching begins several days before the apple buds open at all, or with the opening of the earliest apricot blossoms in the same neighborhood.

Young Stem-mother—Plate 5, fig. 1.

The young stem-mothers, before the first molt, are very dark green in general color; antennæ and legs dusky yellowish green; cornicles very short and black; antennæ stout, 5-jointed,[1] and with sensoria at the distal ends of joints 3 and 4. Length of body, in specimens described, .60 mm.; length of antennæ .28 mm. From eggs taken at Paonia, Colorado, on apple, March 2, 1907.

Adult Stem-mother—Plate 5, fig. 2; and plate 6, fig. 1.

From the same source as the preceding and hatched and reared in the insectary, probably a little under size.

Color a bright green with a little tinge of yellow, head more or less conspicuously dusky brown; cornicles, cauda, eyes, base and tip of beak, tarsi, distal portions of tibiæ, and antennæ, the knees and genital plates, black or blackish; remaining portions of legs and antennæ a little dusky. The lateral thoracic tubercles are present, and similar ones occur on part or all the abdominal segments to the 7th; cornicles nearly straight and gradually tapering to their distal ends. The antennæ are short and 6-jointed, as is usually true with stem-mothers in this genus. The third joint is very much the longest (Plate 6, fig. 1) and is really the union of joints 3 and 4. Sometimes the suture is present, cutting this joint into two. Length of body varying little from 1.50 mm.; **width**, .80 to .90 mm.; antenna, .75 mm.; antenna joints: three, .26 mm.; **four**, .13 mm.; five, .11 mm.; six, .14 mm.; cornicles, .25 mm.

Young of Stem-mothers—Plate 5, fig. 4.

[1] For convenience I shall refer to the flagellum of the last joint of the antenna as a separate joint.

The young lice of the second generation, before their first molt, are a v... pale yellowish green with light to dark red eyes and with legs and anten... pale dusky. Antennæ with third joint longest, nearly equaling joints four ... five together, whole number of joints five, sensoria at distal ends of joi... three and four. The head is large and broad, the thoracic tubercles are well ... veloped and about five similar tubercles occur along either lateral margin ... the abdomen; the cornicles are very stout, being about as broad as long ... about parallel sided. Length of body, .60 to .65 mm.; antenna .35 to .40 m...

Adult Apterous Viviparous Female—Plate 5, fig. 3; and Plate 6, fig. 2.

Described from same lot as preceding young.

General color light green or yellowish green with head, or head and thorax, distinctly yellowish, the head in some specimens somewhat dusky; cornicles, eyes, tarsi, genital plates, cauda, knees, distal ends of tibiæ and more or less of the distal ends of joints four, five and six of the antennæ dusky brown to deep black. Thoracic tubercles distinct, about four to six similar but smaller lateral abdominal tubercles upon either side; cornicles straight and slightly tapering to the outer ends, where there is a moderate flange; cauda upturned, tail-like; vertex gently rounded, antennal tubercles very slight; body pyriform in general shape. Length varying from 1.60 to 2 mm.; length of antenna, 1.20 mm., joint seven usually a little the longest, joints four and five sub-equal (Plate 6, fig. 2); length of cornicles somewhat variable but differing little from .40 mm.; cauda, .19 mm. The orange color at base of cornicles as described by Sanderson in Thirteenth Annual Report, Del. Experiment Station, 1901, I have never seen at any time of the year in this species.

Pupa of Viviparous Female—Plate 5, fig. 6.

In third generation, bred from stem-mothers described above.

Color of abdomen green, more or less tinged with yellow; thorax, above and below, yellowish brown, to pale carneous, the color being deepest on prothorax and middle portion of mesothorax; head of same color with more or less dusky brown that is separated into two lateral patches more or less distinctly by a median lighter line; distal ends of antennæ, eyes, cornicles, wing pads, tarsi, distal ends of tibiæ, most of the femora, and beak, and genital plates black or blackish; cauda green, more or less infuscated about the margins; thoracic and abdominal tubercles as in Apterous Viviparous female. Length of body about 1.80 to 2 mm.; antenna, 1 to 1.10 mm.; cornicles, .32 mm.

Winged Viviparous Female—Plate 5, fig. 6; and Plate 6, fig. 3.

Third generation as in case of pupa described above.

Color of abdomen deep green, without black markings above,[1] head, thorax above and below, cornicles, cauda, genital plates, tarsi and distal ends of tibiæ and femora, black or blackish; costal vein and stigma dusky; venation normal; eyes a very dark red, usually appearing black; lateral tubercles present on prothorax and most of the abdominal segments; middle ocellus upon vertex rather prominent, antennæ upon slight tubercles, third joint with about 6 to 9 rather large flat circular sensoria in a single row, cornicles very gradually tapering to the distal ends, where there is a moderate flange. Length of body, 1.50 to 1.60 mm.; antenna, 1.15 to 1.25 mm. Joints of antenna about

[1] In some of the specimens there are, upon either lateral margin of the abdomen, three or four darker green or dusky spots, but not the good black spots that occur in many species.

follows: Three, .25 mm.; four, .20 mm.; five, .19 mm.; six, .12 mm.; seven, mm. (Plate 6, fig. 3). The antennæ and cornicles of seven alate females om Mr. J. T. Monell taken at St. Louis, Missouri, June 10, 1908, measured as lows in hundredths of millimeters:

Joint 3.	Joint 4.	Joint 5.	Joint 6.	Joint 7.	Cornicle.
26	20	20	12	33	31
29	19	20	11	33	31
29	20	20	11	31	29
27	19	19	11	29	29
26	20	19	11	31	26
27	20	20	11	34	29
31	20	20	12	33	29

The antennæ and cornicles of nine alate females taken at Fort Collins, Colorado, July 10 to August 14, 1908, measured as follows:

Joint 3.	Joint 4.	Joint 5.	Joint 6.	Joint 7.	Cornicle.
27	20	20	12	29	30
26	20	20	11	30	29
34	23	21	11	34	30
28	20	20	11	29	30
29	20	20	11	34	29
27	21	20	12	31	29
29	20	20	11	31	29
31	21	21	12	34	30
29	21	20	11	31	29

Oviparous Female—Plate 5, fig. 8; and Plate 6, figs. 5, 6.

Wingless, variable, but usually dull green in general color with a tinge of rusty yellow; head dusky brown, quite dark in some individuals; eyes, distal half of antennæ, cornicles, cauda, knees, distal ends of tibiæ, tarsi and genital plates black or blackish; thoracic tubercles prominent and a row of smaller ones along either lateral margin of the abdomen; cornicles straight and tapering gradually towards distal ends, where there is a slight flange. Length of body varying little from 1.40 mm.; antenna, .85 mm.; seventh joint fully one-third longer than joint three (Plate 6, fig. 5). Sensoria at the distal ends of joints five and six only. About 10 oval sensoria on hind tibiæ (Plate 6, fig. 6).

Apterous Male—Plate 5, fig. 7; and Plate 6, fig. 4.

General color brownish yellow with dusky brown head. Eyes, cornicles, cauda, genital plates, tarsi, distal ends of tibiæ, and more or less of distal ends of antennæ black or blackish; older individuals darker than the younger; length of body, 1.10 mm.; antenna, .90 mm.; cornicles, .15 mm., cylindrical,

moderate flange at distal end. Antenna joints: Three, .19 mm.; four, .17 mm. five, .14 mm.; six, .09 mm.; seven, .23 mm. long. The sensoria are difficult to see and appear to be variable in number. Near distal end of joint three I have usually found 2 and upon joints four and five about 7 or 8 each (Plate 6, fig. 4). Described from specimens taken September 15, 1907, at Fort Collins.

The Woolly Apple Aphis, *Schizoneura lanigera* Hausm., Plate 5, figs. 9, 10, 11.

Some of the More Important Literature

Aphis lanigera Hausm., Illigers Mag. I, p. 229, 1802.
Schizoneura lanigera Hartig, Germar's Zeit. Ent. III, p. 367, 1841.
Pemphigus pyri Fitch, 1st Rep. Ins. N. Y., p. 5, 1856.
Aphis lanigera Harris, Ins. Inj. to Veg., p. 242, 1862.
Eriosoma lanigera Verrill, Pract. Ent. I, p. 21, 1865.
Eriosoma pyri Riley, Ins. Mo. I, p. 118, 1869.
Schizoneura lanigera Lowe, Ann. Rep. N. Y. Exp. Sta., for 1896, p. 570.
Schizoneura lanigera Marlatt, Circ. 20, Second Ser., Div. of Ent., 1897.
Schizoneura lanigera Garman, Bull. 80, Ky. Exp. Sta., p. 208, 1899.
Schizoneura lanigera Alwood, Spec. Bull. (C. P. C. 45), Va. E. S., 1904.
Schizoneura lanigera Smith, R. I., Bull 23, Ga. State Board of Ent., 1907.

In the warmer fruit growing sections of Colorado this louse lives over winter regularly upon the trunks and limbs as well as on the roots of the trees. Upon the roots it lives in all stages of growth, but upon the top all the lice die except the last brood born in the fall. These leave the places of their birth before molting, and apparently without feeding or growing, to hunt a hiding place that will give them protection for the winter. The hiding places are beneath the dead bodies of the partly or fully grown lice (which all die from the cold), beneath scales of the bark, or about the crown of the tree between the bark and loose dirt. These over-winter lice do not secrete any cottony covering until they begin to feed and grow the following spring. In this respect the woolly aphis has a habit similar to *Chermes coweni*, the last brood of which (var. *coweni*) rest upon the leaves of the red spruce, or (*cooleyi*) on the bark of the blue spruce, without growing or secreting a covering of wax threads from the late summer until they are warmed into activity the following spring. Plate 5, fig. 11, was drawn from one of these over winter young after it had begun to grow in the spring, so it is a little too light in color and a trifle broad across the abdomen for the typical over-winter condition.

We have had no trouble to get the alate females to deposit the true sexual forms in confinement. We have been utterly unable to keep these alate females upon the apple trees to deposit their young. They seem possessed of a controlling instinct to get away from the tree,

that the sexual forms have always been deposited upon the walls of the breeding cages.[1]

NATURAL ENEMIES

The most active natural enemies of the woolly aphis in Colorado have been predaceous insects. We have reared no parasite from it, but, Aug. 21, 1908, Mr. L. C. Bragg brought into my office a female *Aphelinus mali*[2] busily ovipositing in apterous females of this louse. Among the Coccinellids, *Hippodamia convergens* is by far the most abundant destroyer of this louse both upon the eastern and western slopes of the mountains. Mr. E. P. Taylor also took *H. sinuata, Coccinella 9-notata, C. monticola* and *C. transversalis* feeding on this louse in the orchards about Grand Junction, and we have noted *H. transversalis, C. 9-notata, C. monticola, C. frigida,* and *C. 5-notata* (*transversalis* and *transversoguttata*) feeding upon it in eastern Colorado.

Mr. Taylor also reared two syrphus flies at Grand Junction on this louse, namely, *Catabomba pyrastri* Linn. and *Eupeodes volucris* O. S.

Lace-wing flies (Plate 5, figs. 15 and 16) are also very destructive to *Schizoneura lanigera* in Colorado, and especially upon the western slope in the Grand Valley, where Mr. Taylor concluded that they did more than all else to subdue the unusually severe outbreak of this louse in that valley during the early summer of 1907. The Capsid, *Camptobrochus nebulosus* Uhl. we have found a common feeder upon this and some other plant lice in Colorado.

Alate Female—Plate 5, fig. 10.

General color nearly black to naked eye, but the abdomen is really a dark yellowish or rusty brown. Leg, eyes and antennæ are black or blackish, proximal ends of femora and tibiæ may be yellowish, nerves of wings black, the subcostal being very heavy, and the stigma dusky brown to the naked eye, but really a dark green. Third cubital vein sub-obsolete half way to the fork. Cauda and cornicles nearly obsolete.

The yellowish brown color of the abdomen is due mainly to the female embryos showing through, the two sexes being present in about equal numbers, usually four or five of each, but the numbers may vary from three to six. Sixteen winged females dissected gave a total of 66 females and 48 males. Joints three to six of the antennæ are strongly annulate, as shown in Plate 6.

[1] Since writing the above, I have succeeded in obtaining numerous examples of light orange yellow sexual females and the smaller dusky brown males, and a few yellow eggs upon leaves and bark of twigs that had been inclosed six weeks before in small cheese cloth sacks in the orchard. The first egg was obtained Sept. 18, at Ft. Collins, Colorado.

[2] Determined for me by Dr. L. O. Howard.

fig. 19. Length of body, 2.20 mm.; wing, 2.80 mm.; antenna, .80 mm.; joint three, .40 mm.; four, .12 mm.; five, .13 mm.; six, .07 mm.; joint three with about 21 annulations; four with 3 or 4; five with about 5, and six with 1 or or none.

The sexual females are brown ochre in color; the males are dark green, a greenish brown; both sexes without beaks.

Over Winter Young—Plate 5, fig. 11.

The following description is from specimens brought from Delta, Colorado, where they were taken March 28, 1908:

General color a dingy yellowish brown, the head and prothorax being darker, and in some specimens almost black, the head being the darkest part. The antennæ, legs and the distal end of the beak are dusky brown. Length of body, .65 mm. to .75 mm.; the width, .35 mm.; length of body to the end of the beak, which projects caudad some distance beyond the abdomen, is .77 mm.; antenna five-jointed and .27 in length, rather stout and set with a few stout hairs. There are very few hairs over the body. There is some variation in the general color, some specimens being considerable darker than others. As soon as these little lice begin to feed, the color of the abdomen becomes much lighter. A pair of hairs arising at the bases of the tarsal claws of each foot are slightly knobbed at the distal ends.

The European Grain Aphis, *Aphis*[1] *avenae* Fab., the Clover Aphis, *A. bakeri* Cowen, the Rosy Apple Aphis, *A. pyri* Boyer, and the Sweet Clover Aphis, *A. medicaginis* Koch, all occur to some extent in Colorado apple orchards. A discussion of these species is deferred for a later number of the JOURNAL.

APHIDS INFESTING THE PEACH

The Black Peach Aphis, *Aphis persicae-niger* Smith; Plate 5, figs. 12, 13, 14.

Some of the More Important Literature

Aphis persicæ-niger n. sp. Smith, E. F., Ent. Amer. 1890, pp. 101, 201.
Aphis persicæ-niger Smith, J. B., N. J. Exp. Sta., Bull. 72, 1890.
Aphis persicæ-niger Johnson, Md. Exp. Sta., Bull. 55, 1898.
Aphis persicæ-niger Froggart, Miscel. Pub. No. 760, Agrl. Gaz. N. S. W., 1904.

This louse occurs in a few orchards only in Fremont, Delta and Mesa counties. Early in the spring it attacks the tender bark of small limbs and sprouts and often becomes quite numerous before any of the buds open. We have searched in vain for males, sexual females or eggs of this louse.

[1]This louse seems to me to fall readily into the genus *Aphis*. It does not have the very long clavate cornicles characteristic of Passerini's genus *Siphocoryne*. According to Schouten and Kirkaldy *Siphocoryne* becomes a synonym of *Hyadaphis*, Kirkaldy. See Mem., Soc. Entom. Belgium, XII, p. 229.

Adult Apterous Females—Plate 5, fig. 12.

When fully mature these females appear deep shining black, but under a hand lens the margins of the abdomen, the thorax and the basal portions of the antennæ are more or less yellowish or amber brown in color. The legs are dusky yellow with distal ends of tibiæ and tarsi black; cornicles black; cauda dusky brown to blackish, hardly distinguishable; cornicles straight, enlarged slightly towards the base, and with distinct flange at tip. The general shape of the body is very broad for the length, especially in the older individuals. These females are not black until after the final molt. During the nymph stages they vary from very pale to rather dark yellowish brown.

Newly Born, Viviparous Females—Plate 5, fig. 13.

When first born the young lice are very pale, almost a lemon-yellow in color, becoming darker as they grow; eyes dark red; antennæ, cornicles and feet a little dusky. When ready to molt they measure about .70 mm. Cornicles short, stout and with a wide flange; beak extending to a point half way between hind coxæ and tip of abdomen. Length of antenna, .35 to .50 mm.; joints one and two, short, cylindrical, joint one being much the thicker, joint three about as long as one and two together; joint four short, but little longer than two, and with a sensorium at distal end; joint five a trifle longer than four, stout, and with a cluster of sensoria at the distal end; joint six is long spindle-shaped and is about equal to three and four together; division between three and four sometimes wanting.

After first molt the lice become darker, a good salmon color, and measure from 1 to 1.40 mm. in length; antennæ 7-jointed and about two-thirds the length of the body, distal half blackish, cornicles equaling tarsi in length, broad at base and with wide flange.

Winged Viviparous Female—Plate 5, fig. 14; and Plate 6, fig. 7.

General color of body deep shining black; bases of femora, tibiæ, cauda and usually the eighth abdominal segment in front of it, yellowish. No lateral tubercles upon prothorax or abdomen, middle ocellus rather prominent, antennæ upon slight tubercles. Length of body about 1.75 mm.; antenna, 1.80 mm.; cornicles, .23 mm.; the cornicles are a little stouter at base and have a moderate flange; length of wing, 3 mm.; stigma yellowish; venation normal; joints of antenna about as follows: three, .46 mm.; four, .31 mm.; five, .21 mm.; six, .11 mm.; seven, .55 mm.; cauda very small, hardly longer than broad at base; joints three and four of antenna strongly tuberculate with many sensoria, and joint 5 with 2 to 6 similar sensoria (Plate 6, fig. 7).

(Continued in next number.)

EXPLANATIONS OF PLATES

PLATE 5: Figs. 1 to 8, *Aphis pomi;* 1, stem-mother, first instar; 2, adult stem-mother; 3, apterous viviparous female of the second generation; 4, young, first instar, second generation; 5, winged viviparous female of second generation; 6, pupa of third generation; 7, adult male; 8, adult oviparous female. *Schizoneura lanigera*—9 and 10, apterous and alate viviparous females; 11, the small over-winter form. *Aphis persicæ-niger*—12 and 14, adult apterous and alate viviparous females; 13, young viviparous female, first instar; 15, *Chrysopa* sp. and eggs; 16, *Chrysopa* cocoon. The enlargement in each case is marked beneath the figure. This plate is from Bull. 133, Colo. Exp. Sta., by Gillette and Taylor, M. A. Palmer, artist.

PLATE 6: Antennæ, tibiæ and cornicles of *Aphis pomi*, 1 to 6; *Aphis [illegible] sicæ-niger*, 7; *Myzus cerasi*, 8; *Myzus persicæ*, 9–17; *Schizoneura lanigera*, 18–19; egg shell of *Aphis pomi*, 20. Enlarged 80 diameters in each case, except the shell, which is enlarged 20 diameters. This plate is a modification of Plate IV, Bull. 133, Colo. Exp. Sta., by Gillette and Taylor, M. A. Palmer, artist.

SAW FLY LARVAE IN APPLES

By R. L. WEBSTER, *Ames, Iowa*

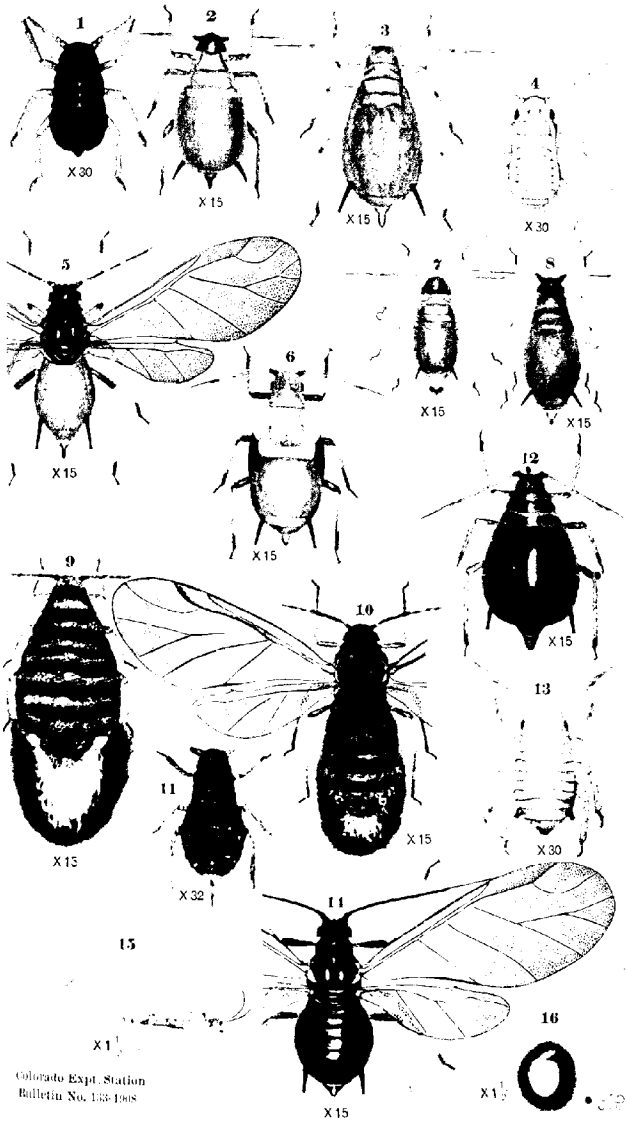
The saw fly, *Taxonus nigrisoma* Nort., sometimes called the "Dock False-worm," has been reported several times as eating into apples. Doctor Fletcher and Professor Lochhead have already noted this rather peculiar habit, so that it is by no means unknown. Three years ago I found several saw fly larvæ in Greening apples, which larvæ turned out to be the above species. The apples were shipped from New York state and were kept in the cellar at my home during the winter. The larvæ were studied in the entomological laboratory at the University of Illinois in March and April, 1905.

The burrow containing the larva extended about half the distance from the skin to the core of the apple. From the exterior the burrow was characterized by a circular, brownish, discolored patch, in the center of which was the small hole made by the larva when entering the apple. The burrow was considerably larger in diameter than the larva itself, and the larva was partially curled up within. None had pupated when they were found early in March.

On March 7th several larvæ were placed in a breeding cage in the laboratory. Small holes were made in the apples, to serve as burrows. The larvæ, however, would not remain in these holes, but pupated, without forming a cocoon, on the damp sand of the breeding cage. Larvæ pupated on the 27th and 29th of March in the laboratory, and the adults emerged the 1st and 3d of April. The average length of the pupal stage was 5.6 days.

Chittenden and Titus have already given an excellent description of the larva in Bulletin 54 of the Bureau of Entomology, so that it is unnecessary to give it here.

About the same time Prof. E. S. G. Titus, then connected with the Bureau of Entomology at Washington, reared this species in the insectary there, from an apple purchased by Mr. Couden in Washington. The adults reared from the apple in Illinois were sent to Professor Titus and were pronounced to be the same species, *Taxonus nigrisoma* Nort.

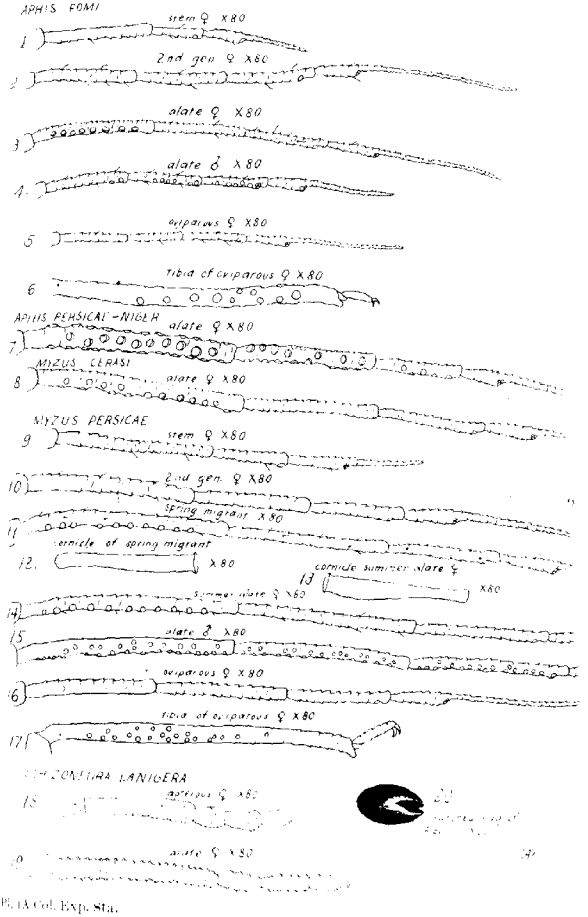


Colorado Expt. Station
Bulletin No. 133-1908

PLATE I

PLANT LICE

MATTHEWS-NORTHRUP WKS. BUFFALO


APHIS FOMI
1
stem ♀ X80
2nd gen. ♀ X80
2
alate ♀ X80
3
alate ♂ X80
4
oviparous ♀ X80
5
tibia of oviparous ♀ X80
6
APHIS PERSICAE-NIGER alate ♀ X80
7
MYZUS CERASI
8
alate ♀ X80
MYZUS PERSICAE
9
stem ♀ X80
10
2nd gen. ♀ X80
spring migrant X80
11
cornicle of spring migrant
12
X80
cornicle summer alate ♀
13
X80
14
summer alate ♀ X80
15
alate ♂ X80
16
oviparous ♀ X80
17
tibia of oviparous ♀ X80
CHERMES LANIGERA
18
apterous ♀ X80
19
alate ♀ X80

The natural food plants of this saw fly seem to be *Rumex* and *Polygonum*, and the usual place of pupation is in the stalks of those plants. According to J. G. Jack, however, the larvæ will even bore into some substance such as partially decayed wood to pupate. If such is the case, apples fallen to the ground, or even apples stored in any place in the vicinity of dock or *Polygonum* infested with this larva, would offer an excellent situation for its hibernation. No doubt the insect could easily be controlled, if it should happen to become noxious, by getting rid of the natural food plants.

NOTES ON MAPLE MITES

By P. J. Parrott

Our native Eriophyidæ have received very little attention among entomologists, so that comparatively little is known of the species that exist in the United States. The studies that have been made on this group of mites have largely been confined to a few species attacking fruit and shade trees, and much of the literature dealing with them consists of mere records of the various species and their respective host plants. In the recent catalog of Acarina of the United States, by Nathan Banks, twenty-seven species were listed which were divided among the genera *Eriophyes, Phyllocoptes, Epitrimerus* and *Cecidophia*. Dr. Alfred Nalepa in his excellent treatise on European Eriophyidæ (Das Tierreich, Lief 4, Eriophyidæ) has enumerated 226 species, distributed among nine genera. With the great diversity of our flora there is evidently a large field for study on this family of mites in this country.

The probable variety and numbers of these interesting creatures has recently been indicated to us in our investigations on the species thriving on maples. In the studies on the mites existing on the foliage of the Silver Maple, *Acer saccharinum* L., Sugar Maple, *Acer saccharum* Marsh, Red Maple, *Acer rubrum* L., Box Elder, *Acer negundo* L., and the Norway Maple, *Acer platanoides* L., fifteen species have been recognized. Among these there were two old world species, *Phyllocoptes gymnaspis* Nal. and the remarkable *Oxypleurites serratus* Nal. collected from the Norway Maple, which are recorded for the first time in this country. This is nearly twice the number of mites recorded on maples abroad and the list of our native species will undoubtedly be further increased as studies are made on other varieties of maples.

The interest of our entomologists in the maple mites is largely con-

fined to the two common and widely distributed species on the H[illegible] and Soft Maples, which are generally known as the Fusiform M[illegible] Gall, *Eriophyes acericola* Garman, and the Bladder Maple Gall, *E[illegible]phyes quadripes* Shimer. Both of these are typical *Phyllocoptes*. [illegible] for the sake of stability of nomenclature should hereafter be refe[illegible] to respectively as *Phyllocoptes aceris-crumena* Riley and *Phylloco[illegible] quadripes* Shimer.

Descriptions of the Hard and Soft Maple Gall Mites

Previous descriptions of both these species are too meager to dis-tinguish them from associated mites. They may be recognized by the following more important characters:

Phyllocoptes aceris-crumena Riley.

Body broadest at the posterior margin of the thoracic shield, with the abdomen gently acuminate. The thoracic shield is broad, with the lateral angles and the anterior margin gently rounded. It does not project over the body. The dorsal setæ are short and are situated near the posterior margin of the shield. The legs are of medium size and the feathered hair has four rays. The thoracic setæ are all present. The first pair are short and fine. The second pair are of medium length, while the third pair are rather stout and of medium length.

The striæ on dorsum of abdomen are coarse and number from 30 to 32, while the striæ on ventrum are much narrower, with fine punctuation in between, and are about 60 in number. The lateral and genital setæ are short. The caudal setæ are long and stout. The accessory setæ are wanting. The first pair of ventral setæ are long; the second pair of ventral setæ are short, while the third pair are very long. The females measure about 170 microns in length and about 60 microns in width.

Phyllocoptes quadripes Shimer.

The anterior portion of the body is wide with the abdomen rather abruptly acuminate. The mites vary in color from white, with pinkish reflections, to a salmon color for the adults and hibernating forms. The thoracic shield is broad and is slightly wider than long. The lateral angles are gently rounded. The anterior margin is gently rounded and slightly projecting, but does not extend over head. The dorsal setæ are short and stout. They are broadly separated and are situated on the posterior margin of the shield, projecting over the first four striæ of the abdomen. The rostrum is large and is broad at the base. The sternum is slightly furcated. The first pair of thoracic setæ are short; the second pair of thoracic setæ are of medium length, while the third pair are long. The legs are of medium length and have the usual spines. The feathered hair has four rays. The claw is a little longer than the feathered hair and is slightly knobbed. The spine on segment three is rather stout and reaches to the feathered hair. The epigynium is of medium size and bears on its lateral margins one pair of setæ, which are short and fine. The epiandrium is arched in shape.

The abdomen has from 37 to 40 coarse striæ on dorsum and from 60 to 65 fine striæ on ventrum. The first pair of ventral setæ are long and stout, and reach to the base of the second pair of ventral setæ. The second pair of

ntral setæ are small and fine. The third pair of ventral setæ are long and ut. The caudal setæ are of medium length. The accessory setæ are not sent. The females measure from 180 to 220 microns long, while the males erage about 170 microns in length.

The Hibernation of the Mites

Many species of mites hibernate under the bud scales, but the location of the winter quarters of these two species seems not to have been determined. While occasionally a specimen may be found in hiding under a bud scale, the buds generally harbor only a very few, which represent but an exceedingly small fraction of the mites that have been produced for that season on the tree. Shimer (Trans. Amer. Entom. Soc. II, 1869, p. 319) suggested that it is probable that they pass the winter, perhaps in the egg stage, on the ground around the tree and in early spring ascend the trunk. Our observations on the hibernating habits of these mites (*P. quadripes* and *P. aceris-crumena*) show that they seek protection just under the loose edges of bark, about the stubbed ends of broken twigs and limbs and about scars of wounds caused by hail and other agencies. For the past two years the beginning of the migration of these mites from the leaves to hibernating quarters occurred on July 12 and 10 respectively. On badly infested trees the mites have been seen assembled in such large numbers on portions of the tree as to give a very distinct reddish tinge to the bark. The mites are only to be found in scattering numbers on the trunks of the trees near the ground. If it should become desirable to spray for these mites, protection could unquestionably be obtained, by the thorough treatment of the trees with an efficient contact insecticide when the mites are migrating in their largest numbers on the bark, or when they are established in their winter quarters.

NOTES FROM CONNECTICUT

By W. E. Britton, *New Haven, Conn.*

The fall canker worm, *Alsophila pometaria* Harris, has caused more damage in various portions of the state than for several years. Apple orchards in the vicinity of Stamford, in Madison, and in Stonington, have been stripped and presented a brown appearance by the middle of June. These orchards, of course, received no spraying or other treatment to destroy the insect. Not only have the apple trees been damaged, but many other kinds of shade and woodland trees have also been more or less injured by the canker worms. Elm trees in

New Haven were in some cases almost defoliated, and the larvæ were observed feeding upon maple, chestnut and hickory. A hedge of California privet was badly eaten, and oak trees at Stonington were partially defoliated. At Old Saybrook the elms were considerably injured last year, and the local village improvement society banded a large proportion of the trees, which are old and large ones, but the sticky bands were not placed upon the trees until after many of the eggs had been laid, as it was supposed that the spring species, *Paleacrita vernata* Peck, was responsible for the injury. Though both species were present, the fall canker worm was far more abundant than the spring species, and doubtless caused a like proportion of damage.

A resident of Stonington, noticing the brown appearance of an apple orchard, inquired if it was the work of the gypsy moth, which is in that vicinity, as he had seen the men working to combat it. Another remarked that we might better stop the gypsy moth work and direct our efforts toward controlling the canker worm, as the latter seemed to be doing more damage. In this region last year a similar remark was made regarding the rose chafer. As a matter of fact, the gypsy moth, which is known to be present in Connecticut only at Stonington, where it infests not more than one square mile of territory, has not been sufficiently abundant there to defoliate trees so as to be noticed by the people. Many know of its presence simply by hearing of it and by seeing the force of men at work. If its presence had not been discovered, however, or if no attempt had been made to control it, doubtless by this time it would have become so abundant as to attract attention. At present about ten men are at work, 14,000 trees have been banded and something over 1,000 caterpillars have been destroyed this season, in spite of the extremely careful search for egg-masses last winter by both state and government scouts, some of the ground being covered several times. Every effort is being made to exterminate this colony, and though much scouting has been done in other parts of the state, especially along the principal highways, no gypsy moths have been found elsewhere.

The peach sawfly, *Pamphilius persicum* MacGillivray, which was so abundant in the orchards of Barnes Brothers, Yalesville, last year, was greatly reduced in numbers by spraying with lead arsenate. The owners sprayed between 4,000 and 5,000 peach trees during the last of June and the first week in July, using from two to three pounds of the poison to fifty gallons of water. An examination of the sprayed trees June 25 showed practically no damage by the insect this year, only an occasional leaf being eaten. In an unsprayed portion of the orchard some distance removed, the larvæ were much more abundant.

and some of the trees were from one fourth to one half defoliated. No spraying has been done this year, but the owners are ready to begin whenever the occasion seems to warrant the outlay. The larvæ observed were mostly on the shoots in the center of the tree, and here the leaves were badly eaten when those at the ends of the branches were untouched. Several other orchards in New Haven County have been examined for the sawfly and though traces of it have been found nearly everywhere, in no case has it been so abundant as it was last year in the Barnes orchard, and I doubt if any spraying will be done to check it this year.

I will here mention a point of considerable interest regarding this species. Doctor MacGillivray described the insect as a new species, but from the manner in which it appeared suddenly as a pest, some of us felt that it might have been introduced. During April Mr. S. A. Rohwer of Boulder, Col., wrote me for specimens, stating that he was specializing on the sawflies. Specimens of both sexes were sent, and these he acknowledged April 28th, and his letter contained the following paragraph:

"In a collection of sawflies which I am naming for the University of Nebraska, I find two specimens of *P. persicum*, taken June, 1903, at West Point, Nebraska. This is rather surprising! It seems to bear out the idea that this pest is a native one."

If the peach sawfly is a native species and occurs in Connecticut and Nebraska, we should expect to find it in other states, and collectors should be on the watch for it. After many observations have been made we shall be better qualified to pass judgment regarding its origin as a pest in this country. The distribution of this insect is certainly an interesting subject.

FACTORS CONTROLLING PARASITISM WITH SPECIAL REFERENCE TO THE COTTON BOLL WEEVIL

By W. Dwight Pierce, *Bureau of Entomology, U. S. Dept. of Agriculture*

It is well understood that the relationships of parasites and hosts are so intimate, and so delicately balanced, that any factor which modifies in any manner the welfare of either species, at the same time reacts on the other species. Consequently, in the case of economic application of parasite control, the worker cannot afford to overlook any aspect in the status or biology of either host or parasite, or of

any other insect, the biology of which may come in contact with [illegible] of either species, directly or indirectly.

A recent excellent review of the economic application of entomophagous insects, by Marchal,[1] contains remarks upon eight factors which may influence or control the amount of parasitism by a given species upon a given host. In studying this paper rather carefully I found that several factors which are important in the boll weevil problem were not considered. With this in view the following notes, mainly on weevil parasites, have been compiled. Twenty-four factors have here been selected as distinct and of sufficient importance for individual mention. These factors are grouped in three divisions. The following were suggested by Marchal: relative fecundity, hyperparasites, co-parasites, other plant-feeding insects, birds and other vertebrate enemies of insects, climate, rapidity in sequence of generations, and retardation of development. Prof. C. W. Woodworth personally suggested the discussion of premature death, fungus diseases, and duplicated mortality. All of the factors have probably received more or less individual mention, but the grouping in this paper and the illustrations are original.

I. Biological Factors Involving Only Host and Parasite

1. *Relative fecundity of host and parasite.* In attempting to utilize parasites or other entomophagous insects, the investigator should always give the advantage of his efforts to the species surpassing, or most nearly approaching the fecundity of the host. For it is very evident that the species having the greatest number of offspring, all other factors being equal, has the advantage.

The relative fecundity is so important that it requires special attention before an extensive economic application is attempted. Not only the total number of eggs laid by each species, but also the period of oviposition should be ascertained if possible. Many species are able to protract considerably the oviposition period, and thus a host might easily gain the advantage over a one-generation parasite. It is not sufficient to ascertain these points for only a portion of the year, because of the varying length of the oviposition period and even of fecundity, due to climatic influences. This may best be illustrated by reference to the studies of Hunter and Hooker[2] on the cattle tick.

[1] "The utilization of auxiliary entomophagous insects in the struggle against insects injurious to agriculture," by Dr. Paul Marchal. Ann. Nat. Agr. Inst., 2d ser., vol. VI, part II. Paris, 1907, pp. 281–354; translated, Popular Science Monthly, April, May, 1908, pp. 352–370, 406–419.

[2] Bureau of Entomology, Bulletin 72.

rgaropus annulatus Say, in which the oviposition period is shown range from eight days in summer to forty-two days in winter.

2. *Relative rapidity of development.* A host which passes through developmental period more rapidly than any of its parasites has greatest chance for safety, and conversely, the parasite with the st rapid development must be considered first in a scheme of para- utilization. The development of the boll weevil may be best ustrated by a curve which shows 38 days from oviposition in April necessary before maturity, 13 days in July, and 30 days in October. development of *Bracon mellitor* Say beginning in June takes about 25 days, in July and August 10–18 days, in late October 175 days. A similar curve may be plotted for each of the five other important species.

Among one-generation weevils, *Lixus musculus* Say may be contrasted with *Desmoris scapalis* Lee. The former completes its development in the fall and hibernates as an adult, but its principal parasite, *Glyptomorpha rugator* Say seldom matures until the following spring. The Desmoris takes about ten months to develop, and yet it is parasitized by *Bracon mellitor*, which develops in mid-summer in 15 days, and is hence capable of breeding several generations at the expense of the more retarded individuals of the Desmoris.

3. *Relative rapidity in sequence of generations.* An instance of greater rapidity in sequence of generations in parasite than in host has just been cited. In the case of the boll weevil and most of its parasites a rapid sequence of generations takes place, but at practically the same rate. There is a notable exception in the cases of the two species of Pediculoides, which attack the weevil. These species reproduce at the rate of a new generation every four days. If other factors did not interfere, the mites could become very efficient enemies of the boll weevil.

4. *Retardation of development.* It is very common among insects for some individuals to develop more slowly than others of the same age. There are many causes for this phenomenon, among which may be classed the character of the food supply. The boll weevil breeds both in squares and bolls, but the development in the latter is much more retarded than in the former. If a cold spell finds immature stages of the boll weevil in dry bolls, the development may be retarded and prolonged until the following spring, but if the individuals are in squares at this time, they will more than likely mature under the heat of the sunshine in the succeeding warm spell and hibernate as adults.

When the parasite species has a short period of activity, this char-

acteristic would tend to increase the chances of the host species. T phenomenon of retarded development is often observed also in pa site species. Entomologists may take advantage of this factor by frigeration of immature parasites until they are needed for work.

5. *Possible parasites per host.* A host may support one or ma parasite individuals at a time. When a parasite places a single e in a very young host and that egg subdivides as the host grows, so times forming a sufficient number of parasites to entirely const the host, the case is designated as polyembryony. This property is suspected as occurring in Tetrastichus on *Orthoris crotchii* Lec., and in several species of Horismenus which attack bruchids and Lixus.

The boll weevil is seldom capable of furnishing food for more than one parasite, although sometimes two are bred. On the other hand none of the boll weevil parasites are able to recognize the existence of another parasite egg or larva upon a prospective host. In fields where the percentage of parasitism has reached a very high point, such evidences of duplication are very numerous. In one instance thirteen eggs of a single species were found on one larva, although only one could possibly mature, cannibalism settling the fate of the rest.

A very striking example is presented by Pediculoides. If a single mite finds a weevil larva, two generations of its offspring can be bred on the original host; in the case of wasp larvæ, even more generations may be reared.

6. *Proportion of sexes.* In computing the possible gains of parasite over host, a very important consideration is the proportion of sexes in the two species. The most striking phenomenon in sexual relationships is of course parthenogenesis, which is supposed to occur with many parasite species, and among hosts is most prominent in the aphids.

In Pediculoides males and females born ovoviviparously from the same parent, mate upon the body of the parent, after which the males die.

Large series of examinations in the boll weevil problem have shown the following percentages of males: the host, *Anthonomus grandis*, has 58 per cent of males, *Bracon mellitor* Say 39 per cent, *Catolaccus hunteri* Cwfd. 22.8 per cent, *Cerambycobius cyanicops* Ashm. 26.7 per cent, *Eurytoma tylodermatis* Ashm. 35.4 per cent, *Microdontomerus anthonomi* Cwfd. 15.3 per cent. The last named species has shown the most remarkable gains.

7. *Condition of host.* When the parasite species requires a certain stage of the host for attack, its activity is sharply limited. This lim-

tion is greatest in egg parasites, especially when the eggs are laid arately, less so when they are in clusters. Parasites which attack lts are not as a rule very numerous, although occasionally recorded. hymenopterous parasites of the boll weevil will attack either va or pupa, although *Bracon mellitor* generally attacks the younger vae. By this habit, this species frequently loses some of its value ough accidental secondary parasitism by other species.

Dissemination. A migratory host species may frequently remove itself many miles from its hereditary enemies by rising in flight. The boll weevils disperse in all directions in the fall of each year, being capable of moving fifty to a hundred or more miles. It is not probable that the parasites can do this, because at present they are known to be more or less limited in their distribution. Some of these parasites certainly can not keep up with such a spread. On the other hand, a migratory host may carry its parasites, as *Toxoptera graminum* Rond. spreads its parasite *Lysiphlebus tritici* Ashm.[1]

9. *Adaptation to new climates.* In the event of a dispersion by either host or parasite, or of an accidental or intentional introduction of either species, it is of course necessary to understand the ability of the species to accommodate itself to the new conditions of weather and perhaps even of food. Although it is a very adaptable species, the boll weevil frequently loses a good part of the territory gained by the last dispersion of the year.

10. *Adaptability to changed food supply.* When the food-plant of a one-plant species, or the host of a one-host parasite, is checked by any agency, a corresponding check is immediately placed upon that insect also. Therefore, when either the host or parasite is thus restricted and the other is capable of adjusting itself to other food-supply, a decided advantage exists in favor of the adjustable species. The boll weevil is absolutely confined to one species of host-plant, but its parasites without exception are able to propagate on several other species of weevils. I have previously called attention to a sudden adaptation of *Cerambycobius cushmani* Cwfd., to the boll weevil, because of the absence of its original host; of *Eurytoma tylodermatis* Ashm., because of the cutting of weeds containing its host; and to the rapid adaptation of *Microdontomerus anthonomi* Cwfd., which in two years has become the predominant boll weevil parasite in certain portions of central Texas.[2]

[1]Webster, F. M., 1907. The spring grain-aphis, or so-called "green bug." U. S. D. A., Bureau of Ent., Circular 93, p. 15.

[2]The economic bearing of recent studies of the parasites of the cotton boll weevil. Jour. Econ. Ent., Vol. 1, pp. 117-122.

11. *Aestivation and hibernation.* The varying conditions of f supply or species habit, which render a resting period imperati bring about a factor of extreme variation. With the boll weevil t entrance into hibernation in a given locality may extend over t months in the fall, and the emergence frequently lasts from March July. Even though a parasite species should carry off all of t developing weevil offspring of the earliest weevils, there would st be many more weevils in hibernation, to continue the species.

12. *Endo- and ecto-parasitism.* Although a minor factor, still t location of attack by a parasite must be taken into consideration. *Zygobaris xanthoxyli* Pierce breeds in the berries of *Xanthoxylum clavaherculis*, and pupates in the ground. It is parasitized internally by *Sigalphus zygobaridis* Cwfd., which does not kill it until the earthen pupal cell is formed. Thus the host prepares a safe retreat for its parasite. The weevil is also parasitized externally by *Caloteleus hunteri* Cwfd., which kills the host larva while it is still in the berry. This instance will suggest how this factor may be important.

13. *Premature death.* In considering the numerical ratio between two species, there should be prepared data to show the percentage of each species which die before fulfilling their sexual functions.

II. Other Biological Factors

1. *Insectivorous vertebrates.* Insects have many enemies among the vertebrates, such as batrachians, reptiles, birds, and mammals, which show very little discrimination between hosts and parasites. Parasitized insects, being uneasy or frantic in their movements, are more open to attack by birds than healthy individuals.

2. *Other plant feeding insects.* The existence of other plant-feeders on the same host plant is an element which has a direct bearing upon the status of the given insect. For example the cotton squares and bolls are bored by the boll weevil, the boll worm, several square borers, such as Calycopis and Uranotes, and even by the leaf worm. The activity of any of these Lepidoptera in squares necessarily cuts down the food supply of the boll weevil. When the leaf worms defoliate the cotton, they stop its growth, eliminate the weevil's food supply, and remove the shelter from the sun, with the result that the survivors must disperse. An extended region of defoliation may cause the starvation of multitudes of flying weevils in search of fresh fields. Finally, the limiting of the food supply and the offspring of the weevils limits the parasites, while the work of the sun made possible by defoliation forestalls them, and the dispersion leaves them still less of a chance for great multiplication. Other examples

f this class may be given. *Anthonomus squamosus* Lec. breeds in ne heads of *Grindelia squarrosa*, which heads are frequently entirely ddled by a large noctuid caterpillar, *Lygranthoecia mortua* Grote, the expense of the developing weevil. This same noctuid consumes ne larvæ of *Desmoris scapalis* Lec. in the heads of *Sideranthus abiginosus*, after the same manner. *Lixus musculus* Say breeds in iem galls of *Polygonum pennsylvanicum*, but is frequently in the ath of a stem mining pyralid, which invariably consumes the weevil tage or its parasites. Any such interference with the host insect, of ourse, affects the welfare of its parasite species.

3. *Predatory insects.* With certain striking exceptions predatory insects do not show much discrimination between insects which might become their prey. The most valuable of all predators are probably the ants. In fact in the boll weevil problem they rank very high as an element of control. Ants carry away every vestige of insect matter from the cell. They may devour larvæ killed by heat or parasites. There is a question therefore as to the mortality to be accredited to them, since some portion might have been accomplished by heat or by parasites. The problem of utilizing ants is as complicated as that of utilizing true parasites, because of the social economy of these insects.

4. *Hyperparasites.* The existence of hyperparasites is always very provoking when the question of controlling an injurious insect is to be solved. Before utilizing the primary parasites the worker must attempt to eliminate the secondary parasites. The entire effectiveness of a given parasite may be destroyed by its hyperparasites, and again these may be almost completely checked by tertiary parasites, and they by quaternary species. Still more provoking are the many cases of species which act according to conditions as primary and secondary, also even tertiary, or as secondary, tertiary, and quaternary, as shown by Howard, Fiske, Silvestri and others. Accidental secondary parasitism, or that phase which is rendered so by the priority of another individual, occurs in the habits of Cerambycobius, Eurytoma, and Microdontomerus on the boll weevil. Frequently the eggs of three species are found on a single weevil larva. Thus it may be seen how the several co-parasites of an insect, although all working to the same end may frequently work at cross purposes, by each destroying some of the others.

5. *Co-hosts.* The subject of co-hosts has received little attention in the past. Not only do phytophagous insects frequently have many host plants, but it is also common for parasites to attack numerous closely related species, or insects with similar habits. In considering

the inter-relationships between a given host and a given parasite, must be remembered that this relationship is intimately connect with the status of all the host-insects or host-plants of the given ho and with all the co-hosts of the given parasite, and all of the ho plants or host-insects of these co-hosts. Thus in the boll weevil pro lem the weevil has only one food plant to be considered, but it h twenty-three primary parasites, three of which are sometimes accid tally supernumerary; also seven predators, which attack the boll w vil or its parasites. Two parasites are known to attack these pred tors. Forty-one weevils are known to serve as co-hosts of the primary parasites, some of them harboring three or four species. Twenty-one parasites, unknown to the boll weevil, attack these co-host weevils. Ninety species of plants are known to serve as hosts to the forty-one co-host weevils. The relationships do not stop here, for we know other weevil hosts of the co-parasites of the co-hosts, and also other parasites to these weevils, and finally hyperparasites on some of these parasites.

6. *Fungous and bacterial diseases.* Although very little is known of the diseases of insects, the fact remains that many are carried off by this factor.

III. General Factors of Control

1. *Climate.* Above all other factors and holding a definite relationship to each, stands climate. As an agency of mortality it displays its powers in many different manners. Frosts, rains, droughts, sunshine, shade, floods, storms and winds may be fatal, under the proper conditions. That these factors do not influence different species in the same manner is well known. The boll weevil is easily killed by the direct rays of the sun falling upon it, or upon the square containing it, when the air temperature is in the nineties. The parasites are not so easily affected. A frost in November, 1907, killed fifty-five per cent of the weevil stages, but had no apparent effect upon the parasite stages present. The relative fecundity, length of oviposition period, rapidity of development, rapidity in sequence of generations, proportion of sexes, dissemination, and aestivation or hibernation are directly controlled by climatic conditions, and more or less arbitrary formulæ may be worked out after much study to represent each relationship. At the same time every plant and animal species involved in the given problem is directly controlled by the same conditions.

2. *Plant conditions.* The condition of the host-plant may very greatly influence the given problem. For instance, it frequently happens that the cotton plant fails to form a complete abscess layer beneath an injured square or boll, and this injured part therefore is al-

ed to dry and hang. Here the heat is not so great, and the ants less likely to find the weevil stage within, but the sun-loving Hymenoptera choose this situation for their attack, in preference to fallen squares. Certain varieties of cotton mature very early, and hence drive the weevils out sooner. Some varieties have less extensive foliage than others and hence permit greater mortality from the sun's rays. Under some conditions proliferation also destroys the immature stages by crushing. Examples of these kinds abound throughout our literature. The protection afforded insects by the plant is often a great protection against many factors, *e. g.*, the protection of cotton bolls compared with squares. The thickness of the carpels and the mass of the fiber in the bolls afford considerably more protection against cold than the squares.

3. *Cultural conditions.* Insect control is frequently effected by means of certain cultural or field practices. In the boll weevil problem it is possible to make parasite control supplement this cultural control, as has been shown in my paper, previously quoted. Our idea is to kill all of the boll weevils that can be killed, and to do this we must add every factor, which can do even a little bit. The parasites can take a given per cent which can not be touched by any given cultural method and furthermore are facilitated in part of their work by definite cultural practice.

4. *Food supply.* In a general way the amount and nature of the food supply of an insect determines its size, its fecundity, its ability to withstand climatic conditions, the rapidity of development, and its movements. The food supply is in turn controlled by climate.

5. *Duplicated mortality.* It goes without demonstration that, with so many factors of mortality possible in the case of a given insect, there will be more or less duplication. Ants carry off the evidence of mortality by both heat, fungus and parasites. Parasites attack and breed upon hosts already killed, and upon those which would have been killed by other factors. Heat kills stages which would have been otherwise killed, and in fact kills these other agencies also. Nevertheless it must be considered that, whether a parasite was needed or not in order to kill a given stage, having done so it is capable of producing offspring which may be of direct and positive value.

THE CITRUS WHITEFLY OF FLORIDA CONSISTS OF TWO SPECIES

By Dr. E. W. Berger, *Gainesville, Fla.*

That the citrus whitefly of Florida represents two distinct and well defined species is a fact well authenticated by careful observations extending over some months. Each species has been found by itself in several localities of the state, but both species may occur in the same locality and live on the same tree. The presence of a delicate net, consisting of hexagonal meshes, covering the eggs of whitefly in certain localities, while the eggs from other localities were perfectly smooth and glossy, is the character which first directed the writer's attention to the subject. Careful comparisons of the larvæ of the first stage revealed the fact that the larva hatched from the reticulated egg develops a waxy border between the marginal spines about as broad as the length of the shorter spines; whereas the larva hatched from the smooth egg develops no such border. Differences in the number of marginal spines of the first stage larvæ of the two species have also been noted, together with differences in the size of these larvæ. Well-marked differences between the larvæ of the fourth stage and also between the pupæ have been recognized. One or two characters for distinguishing the adults also appear to be established.

The species with the smooth eggs is no doubt the one described in 1893 by Riley and Howard in "*Insect Life*" as *Aleyrodes citri*. The species with the reticulated egg appears to be undescribed. It is neither *Aleyrodes aurantii* Maskell, *A. marlatti* Quaintance, nor *A. spinifera* Quaintance, living on citrus in the Northwestern Himalayas, Japan, and Java, respectively; nor is it *A. howardii* Quaintance, from Cuba; nor any other Aleyrodes living on citrus, so far as the writer has been able to determine. It is therefore probably a new species, unless it is some hitherto little known species described as occurring on other plants than citrus.

That the undescribed species in question also exists in Louisiana is evident from Professor H. A. Morgan's figure of the reticulated egg[1] but Professor Morgan was evidently not aware of the existence of two types of eggs, representing two species seriously affecting citrus. He gives the name "*Aleyrodes citrifolii* (Riley, MS.)" to the species observed by him in Louisiana. The manuscript here referred to is evidently the one later published in "*Insect Life*," the name of the insect having in the meantime been changed to *Aleyrodes citri*.

[1]Special Bulletin of the Louisiana State Experiment Station, 1893.

The writer plans to prepare a careful description of this new species for publication in some entomological paper. The foregoing statements are essentially abstracts from a paper presented by the writer before the Florida State Horticultural Society at Gainesville, on May 1908.

A FLEA-BEETLE ATTACKING HOPS IN BRITISH COLUMBIA

By H. J. QUAYLE, *Whittier, Cal.*

A Flea-beetle (*Psylliodes punctulata* Melsh), which occurs widely over the northern part of the United States, but hitherto has not been, apparently, a very important pest of cultivated crops, has been seriously injuring hops in British Columbia during the past year or two. The loss this year in the Chilliwack and Agassiz Valleys is estimated at about 80% of the crop.

During a brief visit to the territory in July it was the writer's chief mission to find the younger stages of the insect, and the eggs, larvæ and pupæ were consequently taken at a depth of from three to six inches from the surface of the ground. The larvæ feed, apparently, on the roots of the hop as well as other plants growing in the yard. But they are not restricted to the growth in hop yards, as may be inferred from finding the beetles widely separated from any hop vines. The adult beetle was found to feed upon the nettle, potato, mangel beet, turnip, dock, lamb's quarter, pigweed and red and white clover, as well as upon the foliage of the hop. There are two points that militate against an effective remedy. First, the continual emergence of the beetle, making a contact spray or mechanical means of capture, such as jarring, of but temporary value; and second, the rapid growth of the hop vines, making frequent repetitions of a poison spray necessary.

Mr. Thomas Cunningham, the provincial fruit inspector, and Mr. Charles Hayes, of the Oregon Station, are at work upon this insect, and we may expect in the near future, a more complete knowledge of its life history and the remedies available for its control.

THE EGGS OF EMPOASCA MALI LE B.

By R. L. WEBSTER, *Ames, Iowa*

Last year, while connected with the Minnesota Experiment Station and doing some work with the apple leaf-hopper, *Empoasca mali* LeB., I succeeded in finding a number of new facts regarding the life history of that species. During the present year, 1908, I have had some opportunity to study the same insect at the Iowa station, and am able to offer some additional data concerning the egg stage of this leaf-hopper. The results of last year's work were given in a paper by Prof. F. L. Washburn at the Chicago meeting of the Association of Economic Entomologists, and were published in the April, 1908, number of the Journal of Economic Entomology.

It is clear that the winter eggs, and those of the rest of the year, are deposited in different parts of the tree. On young apple nursery stock the eggs for the winter are deposited in the bark on the lower portion of the trees, below the first branches, and form tiny pockets or blisters on the bark. These egg blisters I found at Albert Lea, Minnesota, May 20, 1907, on three-year-old apple stock at the Wedge nursery. A young nymph was caught in the act of emerging from one of these egg blisters, so there is no doubt of their identity. This year I have found similar egg blisters on apple stock shipped to Ames from Shenandoah, Iowa.

In Minnesota last year Mr. George G. Ainslee found similar egg pockets on an apple tree which at that time were supposed to be those of *Empoasca mali*. These were much larger than the ones found by myself at Albert Lea, and I now think that they were the eggs of some Membracid which had oviposited in the bark of the apple tree. The egg pocket found and described by Mr. Ainslee measured about 1 mm. by 2 mm., much too large for a nymph, which is only .8 mm. long in the first stage. Those egg pockets found by myself, which I know certainly to be those of *Empoasca mali*, measured .4 mm. by .75 mm., approximately.

Mr. Ainslee found last year in September egg slits in the petioles of apple leaves which he thought to be those of *Empoasca mali*. This observation I have been able to corroborate during the past summer. On July 17th, in the insectary, I noticed several young Empoasca of the first nymphal stage dead on the petiole of an apple leaf, which had been immersed in water for several days. On looking closely over the petiole I found tiny slits in the epidermis near each one of the dead hoppers. These were .6 mm. in length and were a long oval in

outline. The long axis of the slit was parallel to that of the petiole. Evidently the young hoppers had emerged from the egg, but were drowned in the water as soon as they had gotten out. Later, on July 5, under similar conditions, I found a dead nymph of the first stage which was only half way out from the egg slit in the petiole, thus making certain that the true egg slits had been found. These egg slits were found in the green twigs, petioles and lower portion of the mid rib of apple leaves.

Dr. Forbes mentions what he supposed to be the summer eggs of the apple leaf-hopper in slight swellings in the petioles of the leaves.[1] It is probable that the egg slits found by Mr. Ainslie and myself are the same as those referred to by Dr. Forbes.

ANNUAL MEETING OF THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

The Twenty First Annual Meeting of the Association of Economic Entomologists will be held in Baltimore, Maryland, December 28 and 29, 1908. A further announcement giving detailed information concerning the place of meeting and hotel accommodations, railroad rates, etc., will be forwarded to all members about the first of November.

As it is desired to publish the program of the meeting in the next issue of the JOURNAL, and as a copy is also desired for publication in the official program of the American Association for the Advancement of Science, it will be necessary for members desiring to present papers to forward the titles so that they can be in the hands of the Secretary November 15.

In accordance with a resolution passed at the last meeting application blanks for membership have been printed and will be furnished on request.

Baltimore furnishes excellent facilities for holding a convention, and it is hoped that all members will make a special effort to be present at this the Twenty First Annual Meeting of the Association.

S. A. FORBES, President,
Urbana, Ill.
A. F. BURGESS, Secretary,
Washington, D. C.

[1] Twenty-first Rep. State Ent. Illinois, 1906, p. 78.

ANNUAL MEETING OF THE ENTOMOLOGICAL SOCIE Y OF ONTARIO

The Forty Fifth Annual Meeting of this society will be held at Agricultural College, Guelph, on the 5th and 6th of November un the presidency of Dr. James Fletcher of Ottawa. The first ses will be held on Thursday afternoon and the meeting will conti during that evening and the whole of the following day. On Th day evening a popular address will be given by Dr. Felt, State E mologist of New York, and short addresses will also be given by P dent Creelman of the College and Mr. C. C. James, Deputy Mini of Agriculture for Ontario. At the morning and afternoon meetings papers will be read by various members of the society on a variety of topics, both economic and scientific. Visitors from a distance will be very heartily welcomed, and any papers they wish to bring forward will be gladly received. Those who intend to be present are requested to inform Professor Bethune, Ontario Agricultural College, Guelph, Canada, some time during the week previous to the meeting, and to let him know the titles of any papers they wish to present.

C. J. S. BETHUNE.

Scientific Notes

Shade tree work in Brooklyn. The work of this city in the care of its shade trees was extended last year to include a systematic warfare against the tussock moth (our worst enemy) and other insects. In the winter, spring and during the last few weeks, egg masses of the tussock moth have been collected from trees over a large area and burned. The owners of adjoining property have been asked to clean their fences and house walls, through the medium of a postal card and also by verbal notification. The results have been most encouraging. There appears to be a sad lack of knowledge among people as to the simplest methods of caring for their trees and fighting insect pests. Our work has thus served as a very efficient object lesson, if one is to judge from the numerous letters requesting attention from other sections of the city and the hundreds of queries regarding methods and formulæ.

On the hatching of the first brood of caterpillars early in June, all the trees within the cleaned area were banded with cotton batting in order to prevent reinfestation by caterpillars hatching from egg masses on neighboring fences.

A series of chemical and field tests with some of the most important brands of arsenate of lead purchased in the market revealed some very important facts regarding the worthlessness of some that were thought genuine and the good quality of others. This information will prove very helpful another

ear. Our spraying apparatus will also be increased by several more gas spraying machines and many barrel pumps, which will enable us to treat all the trees within the infested area within a very short time, thus destroying the larvæ when still young and most susceptible to poison.

The past season has been a bad one for most insects and many species have been abundant this year that were not injurious last season. The elm leaf beetle has been controlled by spraying with arsenical poisons for the destruction of adults and larvæ, supplemented by destroying the pupæ with kerosene emulsion in August. The bag worm was very abundant in certain centers early in the season, and serious injury was averted by collecting the bags before the eggs hatched.

Several rainy days during the winter were utilized by lectures to the men employed in this work. Not only were the fundamental principles of arboriculture presented but also the work against insect pests, their characteristics, etc., were duly discussed. These talks were copiously illustrated with specimens and colored slides. The gypsy and brown-tail moths were discussed so that should either of these species ever invade Brooklyn, the more intelligent of our men might be able to identify them and call attention thereto. The beneficial effects of these meetings have been proven by the numerous "new" insects brought in for identification, and by the better grade of work done by the men. At present there is a force of 163 men attending to the street trees of Brooklyn alone.

J. J. Levison, Arboriculturist.
Brooklyn, N. Y.

Muscina stabulans (Fallen). During the month of July, 1907, my wife in preparing beets for the table discovered that the stems were infested with maggots and called my attention to the matter. The larvæ were placed in a breeding jar, together with the stems, which were not decayed at this time, though they speedily became so. The larvæ began pupating on July 14, the first fly appearing on the evening of July 22. Dr. L. O. Howard, to whom the adults were submitted for identification, pronounced the insect to be the above named species. They were all undersized individuals and some half dozen or so were reared from the stems. During the past summer I found some very young dipterous larvæ upon a leaf of the common rhubarb or pie plant, which had begun to decay. There issued therefrom no less than 35 full-sized specimens of *Muscina stabulans*. The larvæ were found on the 25th of May and the flies began to issue on June 10. This species seems to be most common in houses about Harrisburg during the months of May and June, almost completely disappearing by July 1.

W. R. Walton.

"The mosquito lit on the sleeping man,
And looked for a place to drill.
'The world owes me a living,' he said,
And at once sent in his bill."

—*Cornell Alumni News.*

Collections from human excreta. The following species of Calypteræ were collected by the writer from human excreta during the months of July and August, 1907, and may properly be added to the list of such flies given by Dr. Howard in his paper concerning the Fauna of Human Excrement. The determinations are by Mr. Coquillett through the kindness of Dr. Howard:

Lucilia sericata, very numerous, collected in large numbers.
Lucilia sylvarum, found but sparingly.
Phormia regina, rather abundant.
Anthomyia radicum, swarming in great numbers.

My endeavors to rear any of these species from excrement have met with failure so far. In the rearings made during the past summer large numbers of a hymenopterous parasite were reared from the pupæ under observation. Mr. H. L. Viereck has identified the same as *Aphaereta muscae* (Ashm). It issued in one instance from an unidentified species of Sarcophaga.

W. R. Walton.

Snow-white linden moth, *Ennomos subsignarius* Hubn. This pest was responsible for serious injuries to beech in the Catskills last year. Extensive defoliation occurred in both the Catskills and the Adirondacks this year. The moths have been exceptionally abundant over wide areas, having been numerous at New York, Kingston, Hudson and Utica, and also have attracted attention in Albany and Troy. The insect does not appear to have been especially destructive in the last two named localities. It may be recalled that this species was well known as a shade tree pest about 1870, and has been remarkable chiefly in later years because of its scarcity. This unusual outbreak is certainly worthy of more than passing notice. The English sparrow, as is well known, feeds readily upon the moths and undoubtedly is an important factor in preventing extensive injuries to shade trees.

E. P. Felt.

Aphid on Gladioli Bulbs. A unique injury by a plant louse, referable to the genus *Aphis*, was brought to attention last spring. The aphids breed in large numbers on the base of the bulbs around the origin of the roots, beginning in early spring as soon as the temperature of the storage warehouse warms up and continuing to reproduce till toward the end of July. The insect is so abundant on certain varieties as to almost fill with exuviæ many of the interstices in small boxes containing a dozen or so bulbs. Exuviæ and dead plant lice can be swept up in large numbers in a badly infested warehouse. Bulbs affected by this insect are sickly, weakened and may fail to flower.

E. P. Felt.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN OF THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

OCTOBER, 1908

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Reprints of contributions may be obtained at cost. Minor line figures will be reproduced without charge, but the engraving of larger illustrations must be borne by contributors or the electrotypes supplied. The receipt of all papers will be acknowledged.—EDS.

The accurate characterization and delineation of destructive insects is one of great importance to the economic entomologist. We believe that the policy of the JOURNAL should be rather broadly construed in this matter, and it is therefore a pleasure to present in this number a well illustrated, descriptive paper by Prof. Gillette—the first part of an important contribution to our knowledge of certain destructive plant lice. This article is quite distinct from the usual and highly serviceable economic account; nevertheless papers of this character are most useful to the practical entomologist who is frequently called upon to discriminate between closely allied, injurious forms. General systematic papers are very serviceable, but comparative descriptions of all stages such as given in the above-mentioned article will do much to make our identifications more accurate. We hope that others will give attention to this more technical side of economic entomology.

The next session of the Association of Economic Entomologists is not remote, and the editor takes this opportunity of calling attention to the desirability of having papers written out prior to presentation. The JOURNAL was started primarily for the purpose of affording a more prompt means of publication for the proceedings, and this end can be attained only by the coöperation of all. The period between the meeting and the issue of the first number in 1909 is limited, and unless the major portion of the papers are in the hands of the secretary at the close of the meeting, the prompt issue of the proceedings will be a matter of considerable difficulty. We trust that all those contemplating the preparation of papers will bear this in mind.

Reviews

Report of the Government Entomologist for the year 1907-1908, by C. P. LOUNSBURY, p. 45–57.

This summarized report shows that a large amount of work has been performed during the past twelve months. Nursery inspection occupied considerable time and is briefly considered, together with a discussion of measures for excluding undesirable stock. A number of destructive insects are briefly noticed and a most interesting method of destroying locust swarms by spraying with an arsenical poison is discussed in some detail. Considerable space is devoted to a Plasmopara or downy mildew affecting grape. Brief observations are given on the value of the codling moth parasite, *Calliephialtes messor*, introduced several years ago into California. Attempts have been made to secure the introduction into South Africa of a red scale parasite from California.

South Africa offers immense opportunities to the economic entomologist, since he has to do with a fauna almost unknown to the practical scientist. Those acquainted with the brilliant work of Prof. Lounsbury in the study of African ticks and other injurious insects, and possessing some knowledge of the possibilities, will agree with the reviewer that it is a mistake and distictly unwise to insist that the entomologist's reports be cut down to mere summarized statements, as has been true in the case under consideration during the past three years. Records of extended investigations can not be stored to advantage in manuscript form. There is always grave danger that important observations may thus be buried beyond recovery. The results of studies should be published, in order that they may become available to others working along the same lines. They in turn would be of service to the original investigator, since the truth is seldom fully established by one series of experiments, but rather by a number of students, each testing the results of the others. Those cognizant of the immense number of injurious insects and the variations in their habits and methods of work will agree in emphasizing most strongly the value of illustrations as a necessary supplement to the text. Frequently the figure of a destructive form leads a man to consult accounts which would otherwise be ignored. An entomological office unable to issue well illustrated, detailed accounts of its work has its usefulness circumscribed in a most deplorable manner.

E. P. F.

Preliminary Report upon Experiments with Powdered Arsenate of Lead as a Boll Weevil Poison, by WILMON NEWELL and T. C. BARBER. Circular No. 23, State Crop Pest Commission of Louisiana, 1908, 40 pp.

This circular gives a brief summary of the results secured by using Paris Green for controlling the boll weevil in Texas and Louisiana since this insect has become a serious pest. A statement of the results of field and cage experiments in Louisiana is given. The work led to the experimental use of powdered arsenate of lead in the spring of 1908. The results of a series of cage experiments where this substance was used are reported, but the data

the field experiments will be published later. In the cage experiments 70 cent of the weevils present were destroyed by applying powdered arsenate lead just before the squares were formed, at the rate of 1½ pounds per c. The use of this substance also proved cheaper and more effective than ris Green in controlling the cotton caterpillar, *Alabama argillacea*. The ular sets forth that the application of poison can be considered as only of the methods of controlling the boll weevil. The results secured should be of great value to the cotton planters of Louisiana and the South.

A. F. B.

The Mound-Building Prairie Ant, by T. J. HEADLEE and GEORGE A. DEAN. Kansas Agricultural Experiment Station Bul. 154, 1908, p. 165–80.

This bulletin makes substantial additions to our knowledge of the life history and habits of this ant, *Pogonomyrmex occidentalis* Cress., a species which has proved of some economic importance because of its injuries to grain fields and also on account of the annoyance inflicted upon man and domestic animals. Experiments have resulted in perfecting a modification of the usual treatment with carbon bisulfid, in that an inverted tub is used to confine the volatile insecticide. There are a number of excellent illustrations, but unfortunately they and the general appearance of an otherwise most excellent bulletin are somewhat marred by the illustrations being on a poor grade of paper.

E. P. F.

State Crop Pest Commission of Louisiana, Second Biennial Report of the Secretary for the years 1906–1907, by WILMON NEWELL, 1908, p. 1–31.

This summarized account of two years' work shows that much has been accomplished. The major portion of the time has been given to the study of the more important pests, such as the cattle tick, boll weevil, white fly and Argentine ant. Nursery inspection is another very important line of work. The report shows that the entomologist has at his disposal the services of five assistant entomologists, in addition to a clerical staff. These men, in cooperation with the United States Department of Agriculture, have done much toward bettering entomological conditions in the southern states. The report, together with the fourteen circulars bound therewith, as an appendix, are well printed, excellently illustrated and most commendable on account of the clear, succinct style.

E. P. F.

A Record of Results from Rearings and Dissections of Tachinidae, by CHARLES H. T. TOWNSEND, U. S. Dept. Agric., Bur. Ent. Tech. S. 12, Prt. 6, 1908, p. 95–118.

This bulletin is an extremely important addition to our knowledge of the Tachinidae, a compact group which many entomologists have tacitly assumed to possess much similarity in habit. Mr. Townsend's investigations show such to be very far from the case. A most striking result is his confirmation

of Sasaski's discovery of the leaf-oviposition habit, it occurring not only in exotic forms, but also in a number of native species. Aside from the well known, and commonly supposed characteristic, host-oviposition habit of many species, Mr. Townsend describes supracutaneous host-larviposition, subcutaneous host-larviposition with an accompanying acute ovipositor, and, most interesting of all, leaf-larviposition. This bulletin likewise records remarkable variations in the habits of the larvæ in different stages. The variations in the number of generations annually and differences in habit are not only interesting to the scientist, but, as shown by Mr. Townsend's observations, are of great importance to the biologist engaged in establishing or propagating these forms. The experiments in providing species producing more than one generation with alternate hosts is another exceedingly practical matter. A most intimate knowledge of parasites is a necessity if the imported material is to be used to the best advantage. The entire bulletin is a credit to all concerned in the investigations as well as to the bureau having charge of the work. It is, we trust, but the precursor of a more extended discussion of this group, and probably the forerunner of equally valuable contributions to our knowledge of other groups of parasites and other natural enemies. It illustrates in an emphatic manner the necessity of exhaustive studies of the biology and various stages of economic insects, and suggests most strongly that an extremely rich field awaits the student of biology in various supposedly well known groups.

E. P. F.

Third Annual Report of the State Entomologist, 1907, by E. F. HITCHINGS, Maine State Department of Agriculture, 1908, p. 1–105, plates 20.

This report, as indicated upon its title page, deals largely with the gypsy and brown-tail moths, besides discussing a number of attractive or destructive species. A detailed account of the work is given, the methods being similar to those in vogue in Massachusetts. A number of excellent plates illustrate this feature of the report. The entomologist reports upon the nursery inspection work, gives interesting notes upon birds, and some details relating to the exhibition of insect collections at state fairs. An unusual feature for an entomological report is an essay on apple orcharding, in which considerable attention is given to various fertilizers, manures, methods of trimming, grafting, thinning, etc., in addition to a discussion of some of the principal injurious insects and fungous diseases.

E. P. F.

The More Important Insects Affecting Ohio Shade Trees, by J. S. HOUSER, Ohio Agricultural Experiment Station Bull. 194, 1908, p. 169–243, 21 plates.

This bulletin comprises most excellent summarized discussions of most of the more injurious species affecting shade trees in Ohio. The introductory matter discusses the necessity of and difficulties in controlling insect pests in cities and emphasizes the advisability of municipal work. It also discusses the relative immunity of trees from insect injuries and advises mixed planting. A new shade tree pest noticed is the Catalpa bud gnat, *Contarinia*

talpae Comst. The bulletin closes with a discussion of spray apparatus d of the standard contact and internal insecticides. The plates are com- sed mostly of original, well selected figures. The process illustrations uld have been materially improved had they been printed upon a better ade of paper. The bulletin as a whole is most commendable and should ve of great service to all interested in shade tree protection.

E. P. F.

How Insects Affect Health in Rural Districts, by L. O. HOWARD, U. S. Department of Agriculture, Farmers' Bulletin 155, 1908, p. 1-29, 16 figures.

This authoritative, summary discussion deals particularly with mosquitoes as carriers of malaria and yellow fever, and with the house fly as a disseminator of typhoid fever. The comparative discussion of the sanitary conditions prevailing in city and country is a particularly valuable feature.

Current Notes

Conducted by the Associate Editor

During the past summer several members of this association have been honored in foreign countries. Among these the following should be mentioned: Prof. Wm. B. Alwood, Charlottesville, Va., has been awarded a silver medal and diploma of the Société National d'Agriculture de France, and the president of the French Republic has conferred upon him the cross of Officer du Mèrite Agricole.

Dr. L. O. Howard, chief of the Bureau of Entomology, has been made an honorary member by the Société National d'Acclimatation de France.

An entomologist highly honored. It is very gratifying to note that Dr. W. J. Holland, member of the Association of Economic Entomologists and former chancellor of the Western University of Pennsylvania, now director of the Carnegie Museum, has been recently honored by both Emperor William of Germany and President Fallieres of the French Republic, who conferred upon him the orders of the Knight of the Crown and Officer of the Legion of Honor. Doctor Holland is the first man in the United States to be thus doubly honored. These decorations will be worn by Doctor Holland only on very special occasions, since we do not, like Europeans, make a practice of wearing such insignia on public occasions. Brother entomologists will unite with us in congratulating Doctor Holland upon the high honors which have befallen him.

Mr. G. D. Smith, a graduate of the Louisiana State University, class of 1908, has been appointed assistant entomologist to the Louisiana State Crop Pest Commission.

Mr. R. C. Treherne of the Ontario Agricultural College, who has been employed by the Louisiana Crop Pest Commission as temporary assistant, has returned to Guelph, Canada, to complete his course of study.

Mr. W. F. Fiske, who was in charge of the Gypsy Moth Parasite Laborat at Melrose Highlands, Mass., sailed for Europe August 25. He will tr in England and France, visiting the museums and securing informa which will be of especial value in the work of importing parasites of g and brown-tail moths.

Mr. Charles W. Flynn, who is taking a medical course at the Universit of Pennsylvania, has been employed during the summer by the Bureau of tomology as temporary assistant in the cotton boll weevil investigations.

Mr. W. Harper Deane has been appointed special field agent of the Bu of Entomology, and will be connected with the investigation of cereal forage crop insects.

Dr. Jas. A. Nelson, formerly honorary fellow in entomology and invertebrate zoölogy at Cornell University, has accepted an appointment with the Bureau of Entomology, Washington, D. C., and will investigate certain problems in the embryology of the honey bee.

Dr. E. F. Phillips and Dr. G. F. White of the Bureau of Entomology spent the summer in southern California, carrying on experiments in treating American foul brood.

Mr. Burton M. Gates and Mr. A. H. McCray, who have been employed in the agricultural investigations of the Bureau of Entomology, were granted a furlough October 1. The former will attend Clark University and the latter will finish his course at the Ohio State University.

Mr. Robert Newstead, lecturer in economic entomology and parasitology in the Liverpool School of Tropical Medicine, will visit Jamaica in November to investigate the ticks and other insects which transmit animal diseases.

At a recent meeting of the Association of Economic Biologists held at Edinburg, Mr. A. E. Shipley, president of the association, delivered an address on "Rats and Their Parasites."

Mr. W. R. Thompson, who has been employed during the summer at the Gypsy Moth Parasite Laboratory, Melrose Highlands, Mass., has returned to Guelph, Ontario, to finish his course at the Ontario Agricultural College, where he is specializing in economic entomology.

Mr. Douglas H. Clemons, who has for the past two years been employed at the same laboratory, has been appointed assistant in the Division of Insects at the U. S. National Museum, Washington, D. C. He will work principally on the coleoptera.

Mailed October 15, 1908.